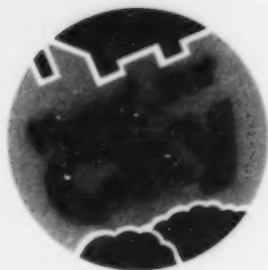


Strategic
Planning
Branch

REPORT



An Econometric Model of the Edmonton Economy

Revised February, 1989

Research Paper Number 27

Research Paper No. 27

**AN ECONOMETRIC MODEL OF
THE EDMONTON ECONOMY**

(Revised)

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IMPORTANT NOTE

This Technical Paper has been prepared by the Forecasting and Policy Development Group, Strategic Planning Branch, Planning and Development Department. The Paper documents research results as part of an ongoing forecasting activity. Neither the methods nor the results have been endorsed by the City of Edmonton.

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AN ECONOMETRIC MODEL OF THE EDMONTON ECONOMY

I. INTRODUCTION

This report is a revised and expanded version of a previous research paper (No. 14). Every section of the paper has been rewritten and expanded. The model has been re-estimated and detailed description of the estimation of each equation is fully documented; simulation of the model has been re-done as well, using a different set of assumptions on world oil prices, interest rates, Canadian economic growth rates, etc.

The 1970's were a time of unprecedented growth for the City of Edmonton, as its population increased by 85,000 from 436,000 persons in 1971 to 521,888 persons in 1981. This resulted in increased pressures on product markets and municipal services, thus causing municipal operating expenditures to rise from \$90 million in 1972 to \$364 million in 1981, at an average annual growth rate of 16.8%. With the introduction of the National Energy Program, rising interest rates and the fall of world oil prices in 1981-82, economic activity slowed down in Alberta and Edmonton. Jobs were lost in most of the sectors, resulting in a drastic increase in unemployment rates. The unemployed responded by migrating to other parts of Canada in search of employment, thus moderating the demand for City services.

With stable oil prices in 1983, growth returned to the provincial economy in 1985. However, this was short lived as world oil prices collapsed in the first half of 1986 and have since remained volatile.

Each phase of the economic cycle brought about a different set of concerns for the City's decision makers. These ranged from the adequacy of municipal services to the size of the City's economic base and municipal revenues. Effective solutions to these issues require an understanding of the current and future economic structure and external environments. Knowledge of the interrelationships among various interacting variables in the Edmonton economic system and the ability to evaluate the impact of external environmental changes on the Edmonton economy can be acquired by a

structural analysis of the economy. This leads to the need for the development of an econometric model for the Edmonton economy.

The Edmonton econometric model was prepared to meet the following objectives:

- 1) to develop a scientific tool based on sound economic and econometric theories for future economic forecasting and impact assessment;
- 2) to prepare consistent and integrated short and medium-term forecasts of the Edmonton economy for use in the preparation of the City's 5-year budget forecasts and the City's annual budget; and
- 3) to assess the impact on the Edmonton economy of major changes in government policies and other external economic factors such as world oil prices, interest rate, Canadian and American economic conditions.

The Edmonton econometric model is an annual model designed for short and medium-term forecasting and simulation. The model consists of approximately 92 equations, of which 57 are stochastic (or structural) equations and the rest are definitional (or accounting) equations. The stochastic equations were estimated and tested using the Ordinary Least Squares method and, when necessary, the Cochrane-Orcutt method. The annual data used for fitting the equations cover the period 1971 to 1986, except for the migration equations which were fitted to the 1975 to 1986 data.

In Section II, the structure of the model and the interrelationships among various blocks of the model are discussed. Specifications of the equations in each block, the theories behind the specifications and estimation of the model are discussed in Section III except the sub-model dealing with the economic activity by industry divisions which are discussed in Research Paper No. 7. Simulated results of the model based on different sets of assumptions on world oil prices and other external factors are shown in Section IV.

II. STRUCTURE OF THE MODEL

The Edmonton model is a simultaneous econometric model rather than an economic base model or an input-output model. The simultaneous type of regional or metropolitan econometric model was pioneered by L. R. Klein (1969) and refined by N. Glickman (1971, 1977) for Philadelphia, by B. M. Rubin and R. A. Erickson (1977, 1980, 1981) for the Milwaukee Metropolitan Area, and by S. F. Duobinis (1981) for the Chicago Metropolitan Area. (See Research Paper No. 7 for a brief discussion).

As shown in the "Flow Chart", the model consists of the following 12 blocks:

1. Alberta and Edmonton general Economic Activity
2. Alberta Demographic Development
3. Edmonton Demographic Development
4. Alberta Labour Market
5. Edmonton Labour Market
6. Wages and Incomes
7. Prices and Interest Rates
8. Edmonton Housing Market
9. Edmonton Downtown Office Space Market
10. Edmonton Construction Sector
11. Edmonton Retail Market
12. Edmonton Industrial Activity

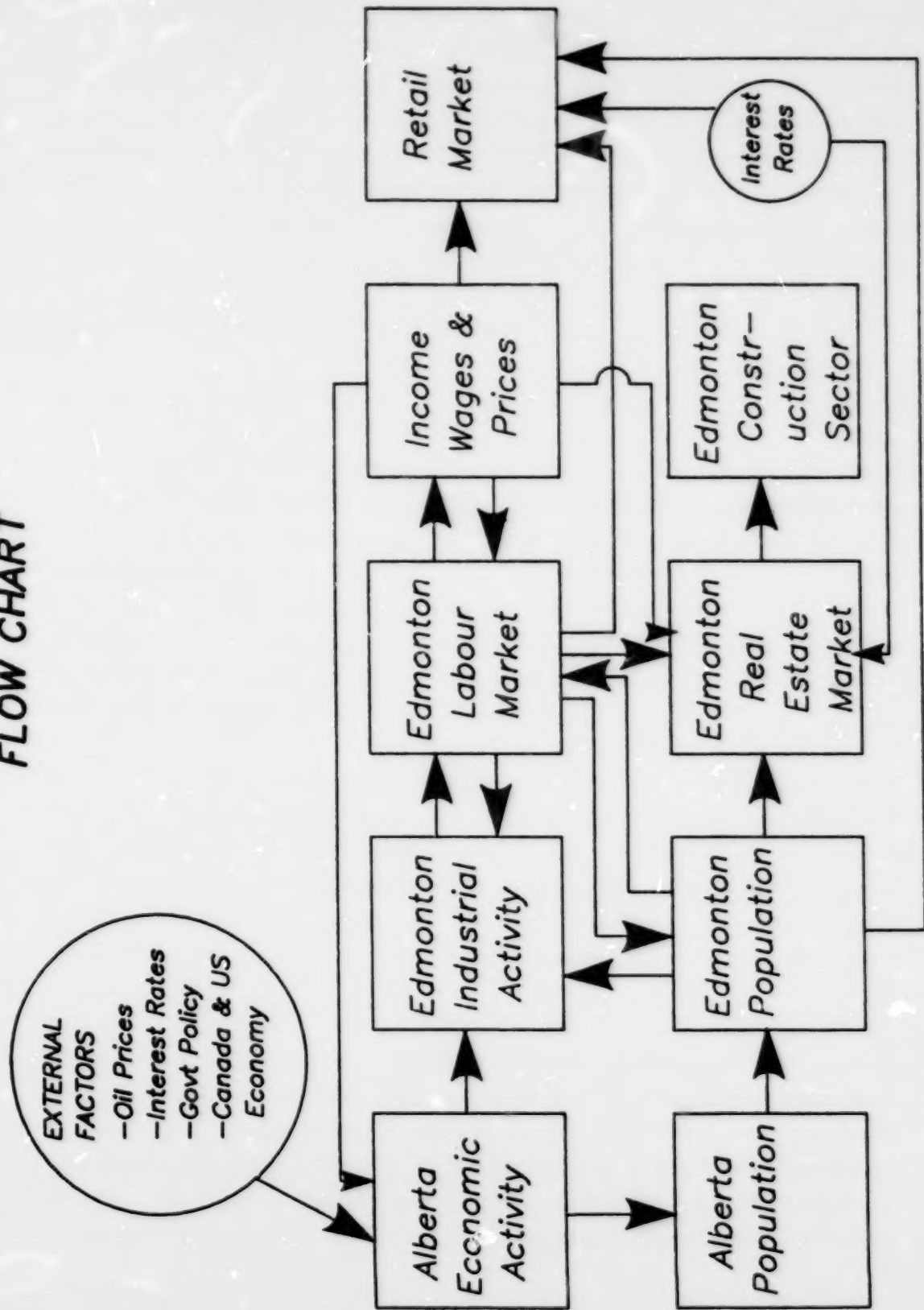
The 12 blocks are inherently inter-related to each other. Within each block, there are numerous equations describing the causal relationships among various economic factors. The arrows on the flow chart show the direction of the causal relationships among the blocks.

The model is linked to the Alberta and Canadian economies so that impacts on the local economy of changes in the provincial and national economy can be evaluated. The world oil price is also included in the model to assess the response of local economic activities to oil price changes. The other external factors included in the model are government policies such as the National Energy Program and interest rates.

Equations in a model may have one of the three types of relationships among variables: simple recursive equations, dependent recursive equations and simultaneous equations. Both the simple and dependent recursive equations have causal relationships among variables flowing in only one direction, while the simultaneous equations have causal relationships among variables flowing in more than one direction. The value of a dependent variable in the simple recursive equations can be determined independently of the current values of other dependent variables in the model; the value of a dependent variable in the dependent recursive equations can only be solved after the current values of other dependent variables in the model are obtained; however, the value of a dependent variable in the simultaneous equations can only be determined simultaneously with values of other dependent variables in the simultaneous system.

The Edmonton Econometric Model consists of all of the three types of equations. The simple recursive equations include equations for mortgage rates, single housing starts, net office space construction, productivity in the manufacturing sector, productivity in the finance sector, productivity in the transportation sector and productivity in the construction sector. The simultaneous equations include equations for consumer price index, consumer price growth rate, real prime rate, Alberta and Edmonton weekly wage earnings, Alberta gross domestic product implicit price index, Alberta real gross domestic product, Alberta GDP growth rate, Alberta net migration, Alberta labor force participation rate, Alberta population, Edmonton CMA population, Edmonton CMA working age population, Edmonton labor force participation rate, Edmonton labour force, Alberta working age population, Alberta labour force, Alberta employment, Edmonton employment, real personal disposable income, Alberta unemployment rate and real world oil prices. The remainder of equations are the dependent recursive equations.

AN ECONOMETRIC MODEL OF THE EDMONTON ECONOMY FLOW CHART





III. ESTIMATION OF THE MODEL

This section presents the structure of equations which describes the causal relationship between a dependent variable and its influential factors. The coefficients of the equations are estimated and tested using data over the 1971-1986 period. The theoretical relationships and estimated results are presented under each block of the model. For each equation, the theoretical relationship is first discussed, followed by its estimated results and test statistics.

1. Alberta and Edmonton General Economic Activity

A. Alberta Gross Domestic Product

Based on the neo-classical economic theory, production is a positive function of capital, labour and technology. Labour input is measured by total employment in the economy. Other things being equal, total output rises as total employment increases, and vice versa. Technological progress is made gradually over time and is normally proxied by a time trend. Technological progress is also a main source of productivity growth which is measured by output per employed worker in the economy. Both measurements of technological progress are tested in this section.

Because of a lack of data, capital input is not directly included in the equation but is indirectly reflected in the cost of capital as measured by the rate of interest. A rise in interest rates increases the cost of investment (and capital) and, therefore, discourages investors from engaging their money in investment, resulting in a decline in total output. Conversely, a fall in interest rates reduces the cost of investment and attract more investment which generates more output.

There are two other factors which had a significant impact on the Alberta economy over the period 1971 to 1986: one is the world oil prices and the other is the National Energy Program. Alberta is a resources-based economy; the oil and gas industry has been the main driving force of the Alberta economic growth. The rises in the world oil prices resulting from the 1973 Arab oil embargo and from the 1979 world oil shortage generated tremendous

investment activity in the Alberta economy, especially in the oil and gas industry, which brought about an economic boom during the 1970s. However, when world oil glut occurred and the world oil prices started to drop in the early 1980s, Alberta economic activities slowed down substantially and the economy plunged into recession.

Furthermore, right before the fall of the world oil prices, the Federal Government adopted a new National Energy Program which introduced several new energy revenue taxes and capped domestic oil prices. This program had a detrimental effect on the energy industry and deepened the decline of Alberta economic activities.

The following equations show the impact on the Alberta gross domestic product of each of the factors described above over the period 1971 to 1986.

$$\text{GDP} = -266.186 + 0.1361 * \text{TIME} - 0.5385 * \text{NEP} + 0.1134 * \text{RWOP}$$

(3.46) (3.45) (5.60) (5.04)

$$-0.0322 * \text{RIR} + 0.0089 * \text{EMPA}$$

(1.99) (7.39)

$$R^2 = 0.9979 \quad R^2 = 0.9968 \quad DW = 2.18 \quad SEE = 0.13 \quad 1971 - 1986$$

$$\text{GDP} = -9.413 + 0.7692 * \text{PRODTY} - 0.2212 * \text{NEP} + 0.0112 * \text{WOP}$$

(18.0) (19.9) (5.61) (3.75)

$$-0.0167 * \text{IR} + 0.0123 * \text{EMPA}$$

(2.87) (111.11)

$$R^2 = 0.9999 \quad R^2 = 0.9998 \quad DW = 2.49 \quad SEE = 0.03 \quad 1971 - 1986$$

Where:

GDP = Alberta gross domestic product in 1971 billions of dollars

TIME = Time, proxy for technological progress

NEP =	National Energy Program. 1 for the years in which the National Energy Program was in effect and 0 for other years.
RWOP =	World oil prices for West-Texas Intermediate crude, deflated by consumer price index, in dollars per barrel.
RIR =	Real Prime interest rate after subtracting consumer price increase, in percent.
EMPA =	Alberta total employment, in thousands of persons
PRODTY =	Productivity measured by output per employed person, in thousands of dollars
R ² =	Coefficient of multiple correlation
R-2 =	Coefficient of multiple correlation, adjusted for degree of freedom
DW =	Durbin-Watson statistic
SEE =	Standard error of estimate.

The above equations indicate that all the factors discussed above accounted for 99.8% or more of the changes in the Alberta gross domestic product over the period 1971 to 1986.

Alberta GDP growth rate (GDPR) can be computed from the following formula:

$$GDPR = ((GDP/GDP_{(-1)}) - 1) * 100$$

Where:

$GDP_{(-1)}$ = Alberta gross domestic product of the previous year

B. Edmonton Gross Domestic Product

Edmonton is the government center of Alberta and a service center for the Alberta oil and gas industry. The structure of the Edmonton economy is more diversified and stable than the Alberta economy. Consequently, it is expected that the Edmonton economy generally moves together with the Alberta economy, although with a smaller degree of fluctuation. Therefore, Edmonton GDP can be estimated from Alberta GDP, based on the following relationship.

$$GDPE = (WR * EMPE) / (WRA * EMPA) * GDP * 1000$$

GDP =	Alberta GDP, in 1971 billions of dollars
GDPE =	Edmonton GDP, in 1971 millions of dollars
EMPA =	Alberta employment, in thousands of persons
EMPE =	Edmonton employment, in thousands of persons
WRA =	Alberta average weekly wage earnings, in dollars
WR =	Edmonton average weekly wage earnings, in dollars

The Edmonton GDP growth rate (GDPER) is calculated from the following formula:

$$GDPER = ((GDPE / GDPE_{(-1)}) - 1) * 100$$

Where:

$GDPE_{(-1)}$ = Edmonton GDP of the previous year

2. Alberta Demographic Development

A. Alberta Population

Population changes are influenced by two factors, natural increase and net migration. The natural increase depends on fertility rate, mortality rate and the existing population base. Both the fertility rate and the mortality rate are rather stable over a short run; natural increase is determined mainly by the existing population base and its age structure. Population is therefore positively related to the previous year's population base and net migration. The estimated equation based on these two determinants is shown below:

$$POPA = 1.0132 * POPA_{(-1)} + 1.0096 * [\frac{1}{4} (MIGNA + MIGNA_{(-1)})]$$

(905.5) (15.9)

$$R^2 = 0.9992 \quad R^{-2} = 0.9992 \quad DW = 1.88 \quad SEE = 7.86 \quad 1972 - 1987$$

Where:

POPA = Alberta population, in thousands of persons
 POPA (-1) = Alberta population of previous year, in thousands of persons
 MIGNA = Alberta net migration, in thousands of persons
 MIGNA (-1) = Alberta net migration of previous year, in thousands of persons

The above equation shows that net migration and previous year's population explained 99.9% of the increases in Alberta population over the 1972-1987 period.

B. Alberta Migration

Alberta's main source of in-migrants is from other provinces of Canada, although international migration makes some contribution as well. People always move from high unemployment regions to low unemployment regions. During Alberta economic boom years, Alberta received many thousands of in-migrants from other parts of Canada. However, during the economic recession period of 1980s, the trend reversed; Alberta lost more people to other provinces than it received. Therefore, Alberta net migration can be assumed to depend on the level of Alberta economic activity, Alberta unemployment rate relative to the unemployment rates in other parts of Canada. The following equation shows the estimated relationships between these two factors and Alberta net migration.

$$\begin{aligned}
 \text{MIGNA} = & 77.31 + 2.3346 * \text{GDPR}_{(-1)} + 2.3066 * \text{GDPR} - 63.844 * \text{URA}_{(-1)} / \\
 & (3.99) \quad (3.26) \quad (4.25) \quad (2.76) \\
 & \text{URC}_{(-1)} - 58.609 * \text{URA/URC} + 15.193 * \text{MIGNADUM} \\
 & (2.55) \quad (1.69)
 \end{aligned}$$

$$R^2 = 0.9738 \quad R^{-2} = 0.9575 \quad DW = 1.98 \quad SEE = 6.95 \quad RHO = 0.2207$$

1972 - 1986

Where:

MIGNA = Alberta net migration, in thousands of persons

GDPR = Alberta GDP growth rate, in percent
 GDPR₍₋₁₎ = Alberta GDP growth rate of previous year, in percent
 URA = Alberta unemployment rate, in percent
 URA₍₋₁₎ = Alberta unemployment rate of previous year, in percent
 URC = Canada unemployment rate, in percent
 URC₍₋₁₎ = Canada unemployment rate of previous year, in percent
 MIGNADUM = Dummy variable for the methodological change in estimating migration in 1975 and after.

This equation indicates that 97.4% of Alberta net migration changes were attributable to the Alberta boom-and-bust economic growth and the level of Alberta unemployment rate compared to the level of unemployment rate in the rest of Canada over the 1975 to 1986 period.

Similarly, Alberta total number of in-migrants depends on Alberta general economic activity and employment opportunity in Alberta as compared with other provinces. The estimated equation is shown as follows:

$$\begin{aligned}
 \text{MIGINA} = & 158.47 - 173.46 * \text{URA/URC} + 0.0644 * \text{EMPA} + \\
 & (7.12) \quad (13.42) \qquad (2.94) \\
 & 3.1606 * \text{GDPR} \\
 & (5.11)
 \end{aligned}$$

$$R^2 = 0.9803 \quad R^{-2} = 0.9718 \quad DW = 1.62 \quad SEE = 7.29 \quad RHO = -0.1$$

1975 - 1986

Where:

MIGINA = Alberta total number of in-migrants, in thousands of persons
 URA = Alberta unemployment rate, in percent
 URC = Canada unemployment rate, in percent
 EMPA = Alberta employment, in thousands of persons
 GDPR = Alberta GDP growth rate, in percent

The above equation demonstrates that 98% of the changes in the Alberta total in-migration were accounted for by changes in the Alberta economic growth

rate, Alberta total employment and the level of Alberta unemployment rate relative to the level of Canada unemployment rate during the period 1975 to 1986.

Alberta total number of out-migrants can be calculated from the following equation:

$$\text{MIGOTA} = \text{MIGINA} - \text{MIGNA}$$

Where:

MIGOTA = Alberta total number of out-migrants, in thousands of persons

MIGINA = Alberta total number of in-migrants, in thousands of persons

MIGNA = Alberta total net migration, in thousands of persons.

3. Edmonton Demographic Development

A. Edmonton Population

Edmonton population is assumed to follow the same trend as Alberta population, except it increases at a higher rate than Alberta population. The following estimated equation describes their relationship.

$$\text{POPE} = 337.75 + 6.24 \text{ E} - 5 * \text{POPA} * * 2 + 95.511 * \text{POPEDUM}$$

(72.22) (56.11) (24.72)

$$R^2 = 0.9978 \quad R^{-2} = 0.9975 \quad DW = 1.62 \quad SEE = 4.56 \quad 1971 - 1987$$

Where:

POPE = Edmonton population, in thousands of persons

POPA = Alberta population, in thousands of persons

POPEDUM = Dummy variable for methodological and boundary changes for 1986 and after.

Like Alberta population, Edmonton population changes are determined by natural increases and net migration. The following equation reflects these relationships.

$$\text{POPE} = 1.0151 \text{ POPE}_{(-1)} + 1.3081 \text{ MIGNE} + 44.626 \text{ POPEDUM}$$

(94.08) (1.26) (2.54)

$$R^2 = 0.9491 \quad R^{-2} = 0.9413 \quad DW = 2.62 \quad SEE = 21.47 \quad 1971 - 1987$$

Where:

POPE = Edmonton population, in thousands of persons
 POPE₍₋₁₎ = Edmonton population of previous year, in thousands of persons
 MIGNE = Edmonton net migration, in thousands of persons
 POPEDUM = Dummy variable for methodological and boundary changes for 1986 and after.

This equation indicates that Edmonton net migration and Edmonton population size of previous year explained 94.9% of the Edmonton population growth over the 1971 to 1987 period.

B. Edmonton Migration

Edmonton net migration not only follows the trend of Alberta net migration, but it also depends on employment opportunities existing in Edmonton. Edmonton net migration is therefore a function of Alberta net migration and Edmonton employment. The estimated equation is shown below:

$$\text{MIGNE} = -12 + 0.1544 * \text{MIGNA} + 0.0357 * \text{EMPE}$$

(3.44) (8.65) (3.28)

$$R^2 = 0.8704 \quad R^{-2} = 0.8488 \quad DW = 2.26 \quad SEE = 2.18 \quad 1972 - 1986$$

Where:

MIGNE = Edmonton net migration, in thousands of persons

MIGNA = Alberta net migration, in thousands of persons
EMPE = Edmonton employment, in thousands of persons.

This equation shows that 87% of the changes in Edmonton net migration were attributable to the changes in Alberta net migration and Edmonton employment opportunity over the period 1972 to 1986.

Alternatively, Edmonton net migration may be influenced by the Alberta unemployment rate relative to the Canadian unemployment rate, the growth rate of Alberta economy and local employment opportunities. Therefore, Edmonton net migration can be alternatively expressed by the following equation:

$$\text{MIGNE} = 0.8 - 20.8796 * \text{URA/URC} + 0.5606 \text{ GDPR} + 0.0051 * \text{EMPE}$$

(9.88)
(4.97)
(9.77)

$$R^2 = 0.9030 \quad R^{-2} = 0.8868 \quad DW = 1.96 \quad SEE = 1.89 \quad 1972 - 1986$$

Where:

MIGNE =	Edmonton net migration, in thousands of dollars
URA =	Alberta unemployment rates, in percent
URC =	Canada unemployment rate, in percent
GDPR =	Alberta GDP growth rate, in percent
EMPE =	Edmonton employment

This equation shows that 90% of the changes in Edmonton net migration were accounted for by the Alberta economic growth rate, Edmonton employment, and Alberta unemployment rate relative to Canada unemployment rate during the period 1972 to 1986.

Historical information on the total number of in-migrants moving into Edmonton from other parts of Alberta, other provinces and other countries is not available, hence the relationship between the total number of in-migrants into Edmonton and the determinant factors can not be estimated by using the regression method. However, it seems to be reasonable to assume that

Edmonton total in-migrants is influenced by Alberta total in-migrants and Edmonton employment, and the coefficients for these two determinants are similar to those in the equation of Edmonton net migration. However, the constant term has to be adjusted by a positive factor to reflect the portion of migrants moving into Edmonton from other parts of Alberta (approximately 18,000 persons in 1987).

Therefore, the equation for Edmonton total in-migrants can be expressed as follows:

$$\text{MIGINE} = 6 + 0.1544 * \text{MIGINA} + 0.0357 * \text{EMPE}$$

Where:

MIGINE = Edmonton total in-migrants, in thousands of persons

MIGINA = Alberta total in-migrants, in thousands of persons

EMPE = Edmonton employment

Total number of people moving out of Edmonton can be estimated from the following equation:

$$\text{MIGOTE} = \text{MIGINE} - \text{MIGNE}$$

Where:

MIGOTE = Edmonton total out-migrants, in thousands of persons

MIGINE = Edmonton total in-migrants, in thousands of persons

MIGNE = Edmonton net migration, in thousands of persons.

4. Alberta Labour Market

A. Employment

The factors which affect the labour market in Alberta are investigated in this section. The economic structure may change over time, but the changes take place only gradually. Some of the basic structures of the economic system

remain unchanged, especially the institutional components. Therefore, most of people employed this year are expected to remain employed next year. This implies that the level of employment this year will influence the level of employment next year. In addition, the level of economic activity will influence the level of employment. When the level of general economic activity is high, demand for labour will be high; and vice versa. The wage rate is an important factor affecting both demand for and supply of labour. While a higher wage rate has a dampening effect on the demand for labour, it has a positive impact on the supply of labour. The direction and the size of employment impact of a higher wage rate depend upon the net difference of these two opposite effects. The following equation presents the estimated impact on total employment in Alberta of the three factors described above.

$$\text{EMPA} = -149.18 + 0.7724 * \text{EMPA}_{(-1)} + 46.8046 * \text{GDP} - 0.5705 * \text{WRA}$$

(3.28) (6.75) (13.82) (3.30)

$$R^2 = 0.9978 \quad R^{-2} = 0.9971 \quad DW = 2.40 \quad SEE = 8.71 \quad RHO = -0.29$$

1972 - 1986

Where:

EMPA = Alberta total employment, in thousands of persons
 EMPA (- 1) = Alberta total employment, in the previous year
 GDP = Alberta gross domestic product, in 1971 billions of dollars
 WRA = Alberta weekly wage earnings, in dollars.

The above equation demonstrates that the level of Alberta economic activity, Alberta wage rates, and Alberta total employment in the previous year together explained 99.8% of the changes in the Alberta total employment in the current year over the 1972 to 1986 period.

Besides, the size of total labour force is expected to have a positive impact on the level of total employment. With this variable included in the above equation, the employment equation becomes:

$$\text{EMPA} = -185.98 + 0.667 * \text{EMPA}_{(-1)} + 41.4124 * \text{GDP}$$

(3.29) (4.80) (7.12)

$$+ 0.2633 * \text{LFA} - 0.7929 * \text{WRA}$$

(3.04) (1.26)

$$R^2 = 0.9981 \quad R^{-2} = 0.9972 \quad DW = 2.00 \quad SEE = 8.54 \quad RHO = -0.20$$

1972 - 1986

Where:

EMPA = Alberta total employment, in thousands of persons
 GDP = Alberta GDP, in 1971 billions of dollars
 LFA = Alberta labour force, in thousands of persons
 WRA = Alberta weekly wage earnings, in dollars.

This equation shows that the four factors explained 99.8% of the changes in Alberta total employment over the same period.

B. Participation Rates

Labour force participation rate is determined by the socio-economic factors which influence the supply side of the labour market. Employment opportunity is an important factor influencing decisions to enter the labour market. When employment opportunities are abundant and it is easy to find a job, people are encouraged to enter the labour force. The employment opportunity is reflected in the level of general economic activity which is measured by the gross domestic product (GDP). Therefore, the labour force participation rate is expected to be positively related to the level of real GDP.

Similarly, the unemployment rate is expected to affect the labour force participation rate. There are two opposite forces affecting how the unemployment rate may influence the participation rate. When the economy is in recession and the unemployment rate is high, additional workers may have to enter the labour market to bolster declining family income. On the other hand, some unemployed workers may give up the apparently hopeless job search and withdraw from the labour market. Therefore, the relationship of the

unemployment rate with the participation rate depends on which force is stronger than the other. However, financial considerations are expected to override the frustration of job-seeking, because unemployment insurance payments last for a limited duration only. With the number of additional workers expected to exceed the number of discouraged workers during a recession, the participation rate is expected to relate positively to the unemployment rate in the previous year.

It is a general belief that people always strive to maintain or improve their living standards during their lifetime which can be measured by the real personal income per capita. One way to increase their income is for themselves or their spouses to enter the labour market if they are currently out of the market. A higher personal income per capita in the previous year, therefore, tends to raise the labour force participation rate in the current year.

The sex composition of the working age population (age 15 and above) has also some bearing on the overall participation rate. Historically, the female participation rate was lower than the male participation rate. Although the difference between the two rates has been narrowing over time, it is a slow process and the gap is not expected to completely close in the foreseeable future. Therefore, the higher the percentage of the total working age population accounted for by the female working age population, the lower the overall participation rate.

The estimated equation including all of the factors described above is shown below:

$$\begin{aligned} \text{PRA} = & 108.35 + 0.972 * \text{GDP} + 0.0994 * \text{URA}_{(-1)} + 0.00045 * \text{RPY}_{(-1)} \\ & (5.99) \quad (7.65) \quad (3.18) \quad (2.89) \\ & - 1.1507 * \text{FWAP} \\ & (3.20) \end{aligned}$$

$$R^2 = 0.9940 \quad R^{-2} = 0.9916 \quad DW = 2.15 \quad SEE = 0.28 \quad 1972 - 1896$$

Where:

PRA =	Alberta labour force participation rate, in percent
GDP =	Alberta gross domestic product, in 1971 billions of dollars
URA (-1) =	Alberta unemployment rate of previous year, in percent
RPY (-1) =	Alberta real personal income per capita of previous year, in 1981 dollars
FWAP =	Female share of Alberta working age population, in percent.

The above equation indicates that 99.4% of the changes in the Alberta labour force participation rate were due to the changes in the level of Alberta economic activity, Alberta unemployment rates, Alberta real personal disposable income and the sex composition of Alberta working age population over the period of 1972 to 1986.

C. Labour Force

Once the labour force participation rate is determined, total labour force can be obtained by multiplying total working age population by the labour force participation rate, that is,

$$LFA = PRA * WAPA$$

Where:

LFA =	Alberta total labour force, in thousands of persons
PRA =	Alberta labour force participation rate, in percent
WAPA =	Alberta working age population, in thousands of persons.

D. Unemployment Rates

Unemployment rates can be calculated by dividing the unemployed labour force, which is the difference between total labour force and total employment, by total labour force and multiplying the ratio by 100, that is,

$$URA = 100 * (LFA - EMPA) / LFA$$

Where:

URA = Alberta unemployment rate, in percent
LFA = Alberta total labour force, in thousands of persons
EMPA = Alberta total employment, in thousands of persons

E. Working Age Population

The working age population is mainly determined by the size of total population in the province. The relationship is estimated as follows:

$$\text{WAPA} = -316.82 + 0.8773 * \text{POPA}$$

(6.69) (39.52)

$$R^2 = 0.9986 \quad R^{-2} = 0.9984 \quad DW = 1.90 \quad SEE = 9.5 \quad RHO = 0.58$$

1971 - 1986

Where:

WAPA = Alberta working age population, in thousands of dollars
POPA = Alberta total population, in thousands of dollars.

This equation shows that 99.9% of the changes in Alberta working age population were related to Alberta total population changes over the period 1971 to 1986.

5. **Edmonton Labour Market**

A. Employment

Edmonton labour market conditions follow a similar trend to Alberta labour market conditions. Those factors affecting the Alberta labour market would influence the Edmonton labour market as well. Therefore, total employment in Edmonton is influenced by Edmonton total employment in the previous year, the level of local economic activity, the prevailing wage rates and total labour

force in Edmonton. The estimated relationships between these factors are shown below:

$$\begin{aligned} \text{EMPE} = & -78.34 + 0.2640 * \text{EMPE}(-1) + 9.7392 * \text{GDP} - 0.4243 * \text{WR} \\ & (4.50) \quad (3.68) \quad (5.24) \quad (7.07) \\ & + 0.9577 * \text{LF} \\ & (8.77) \end{aligned}$$

$$R^2 = 0.9969 \quad R^{-2} = 0.9956 \quad DW = 1.76 \quad SEE = 3.15 \quad RHO = 0.28$$

1972 - 1986

Where:

EMPE = Edmonton total employment, in thousands of persons
 EMPE (-1) = Edmonton total employment of previous year, in thousands of persons
 GDP = Alberta gross domestic product, in 1971 billions of dollars
 WR = Edmonton weekly wage earnings, in dollars
 LF = Edmonton labour force, in thousands of persons

This equation shows that 99.7% of the changes in Edmonton total employment were attributable to the level of Alberta economic activity, the level of Edmonton wage rates, the size of Edmonton labour force and the level of Edmonton total employment in the previous year over the period 1972 to 1986.

B. Participation Rates

The labour force participation rate in Edmonton is related to the growth rate of the Alberta economy, the unemployment rate in Edmonton in the previous year and the real personal income of previous year in Edmonton. The female share of Edmonton working age population is expected to have an impact on the overall participation rate, but lack of data prohibits us from including this factor in the following equation:

$$PR = 38.55 + 0.2194 * GDPGR - 0.2027 * UR_{(-1)} + 0.00276 * RPY_{(-1)}$$

(13.94) (2.64) (2.35) (11.58)

$$R^2 = 0.9448 \quad R^{-2} = 0.9298 \quad DW = 2.12 \quad SEE = 1.0 \quad 1972 - 1986$$

Where:

PR = Edmonton labour force participation rate, in percent
 GDPGR = Alberta GDP growth rate, in percent
 UR₍₋₁₎ = Edmonton unemployment rate of previous year, in percent
 RPY₍₋₁₎ = Alberta real personal income per capita of previous year, in 1981 dollars

This equation demonstrates that 94.5% of the changes in the Edmonton labour force participation rate were due to the changes in the Alberta growth rate, Edmonton unemployment rates and the real personal income during the period 1972 to 1986.

C. Labour Force

Total labour force in Edmonton is determined by the labour force participation rate obtained from above equation, and total working age population in Edmonton, that is,

$$LF = PR * WAP$$

Where:

LF = Edmonton total labour force, in thousands of persons
 PR = Edmonton labour force participation rate, in percent
 WAP = Edmonton working age population, in thousands of persons.

D. Unemployment Rates

The unemployment rate in Edmonton can be derived from the following equation:

$$UR = 100 * (LF - EMPE) / LF$$

Where:

UR = Edmonton unemployment rate, in percent
 LF = Edmonton labour force, in thousands of persons
 EMPE = Edmonton total employment, in thousands of persons

E. Working Age Population

Similar to Alberta, the working age population in Edmonton is a positive function of Edmonton population size. The estimated relationship between them is shown below:

$$WAP = -81.41 + 0.8826 * POPE$$

(2.02) (13.36)

$$R^2 = 0.9273 \quad R\text{-}2 = 0.9221 \quad DW = 1.58 \quad SEE = 21.0 \quad 1972 - 1987$$

Where:

WAP = Edmonton working age population, in thousands of persons
 POPE = Edmonton population, in thousands of persons

The above equation shows that Edmonton total population explained about 93% of the change in Edmonton working age population over 1972 to 1987.

6. **Wages and Income**

A. Wage Rates

Although Alberta wage rates and Edmonton wage rates followed a very similar trend, Alberta wages averaged higher than Edmonton's over the past two decades. Both equations are estimated separately in this section.

Wage negotiations between unions and employers are usually influenced by the rate of inflation, as measured by the increase of the consumer price index, and

by the rate of unemployment. During a period of high inflation rates, workers tend to demand for higher wage increases to compensate for the loss of their purchasing power. Conversely, during a recession with a high rate of unemployment, workers tend to exercise restraint in their wage demands. Therefore, a rise in consumer prices has a positive impact while an increase in the unemployment rate has a negative impact on the wage settlements. These relationships are tested and estimated for Alberta and Edmonton as follows:

$$\text{WRA} = 4.1363 * \text{CPI} - 6.4384 * \text{URA}_{(-1)}$$

(74.62) (8.18)

$$R^2 = 0.9959 \quad R^{-2} = 0.9956 \quad \text{DW} = 1.85 \quad \text{SEE} = 7.1 \quad \text{RHO} = -0.26$$

1972 - 1986

$$\text{WR} = -10.22 + 3.8644 * \text{CPI} - 3.6437 * \text{UR}_{(-1)}$$

(3.04) (71.95) (8.35)

$$R^2 = 0.9976 \quad R^{-2} = 0.9972 \quad \text{DW} = 1.94 \quad \text{SEE} = 5.34 \quad \text{RHO} = -0.43$$

1972 - 1986

Where:

WRA = Alberta weekly wage earnings, in dollars
 WR = Edmonton weekly wage earnings, in dollars
 CPI = Edmonton consumer price index, 1981 = 100
 URA₍₋₁₎ = Alberta unemployment rate of previous year, in percent
 UR₍₋₁₎ = Edmonton unemployment rate of previous year, in percent

Both equations indicate that consumer prices and unemployment rates together explained over 99% of the changes in Alberta and Edmonton weekly wage earnings during the period 1972 to 1986.

The percentage changes of the weekly wage earnings can be calculated by the following formulas:

$$WRAR = (WRA / WRA_{(-1)} - 1) * 100$$

$$WRR = (WR / WR_{(-1)} - 1) * 100$$

Where:

WRAR = Percent changes of Alberta's weekly wage earnings

WRR = Percent changes of Edmonton's weekly wage earnings.

B. Incomes

There are two types of income used in this model; one is personal income per person, the other is personal disposable income per person. Both incomes are measured in 1981 dollars, both deflated by the consumer price index.

Both the personal income and the personal disposable income per person are expected to be positively influenced by such factors as the average wage rates, the total employment in Edmonton, and the general economic conditions in Alberta.

$$RPY = 3559.30 + 2.2847 * WR + 19.2876 * EMPE + 164.238 * GDP$$

(10.70) (2.44) (7.79) (2.31)

$$R^2 = 0.9975 \quad R^{-2} = 0.9969 \quad DW = 2.37 \quad SEE = 93.23 \quad RHO = 0.27$$

1971 - 1986

$$RPDY = 2385.30 + 11.4921 * EMPE + 321.602 * GDP$$

(9.63) (3.63) (3.96)

$$R^2 = 0.9928 \quad R^{-2} = 0.9916 \quad DW = 2.28 \quad SEE = 121.98 \quad RHO = 0.21$$

1971 - 1986

Where:

RPY =	Alberta real personal income per person, in 1981 dollars
RPDY =	Alberta real personal disposable income per person, in 1981 dollars.
WR =	Edmonton weekly wage earnings, in dollars
EMPE =	Edmonton total employment, in thousands of persons
GDP =	Alberta gross domestic product, in 1971 billions of dollars.

In the real personal income equation, wage rates, total employment and Alberta general economic conditions together explained 99.8% of the changes in the real personal income over the period 1971-1986. In the real personal disposable income, both total employment and Alberta general economic conditions accounted for 99.3% of the changes in the real personal disposable income.

The percentage increase of the real personal income (RPYR) can be calculated by the following formula:

$$\text{RPYR} = (\text{RPY}/\text{RPY}_{(-1)} - 1) * 100$$

7. Prices and Interest Rates

A. Consumer Prices

Price advance is caused by two forces, an increase in demand called "demand pulled" and a rise in cost called "cost pushed". Changes in the consumer prices are also affected by these two factors.

Demand for consumer goods is influenced by the general economic conditions and the level of wage earnings. During a period of high level of economic activity and high level of wage income, demand for consumer goods rises. As a result, the consumer prices are forced to go up.

Producers or suppliers tend to raise the prices of their products when their costs increase. There are two principal cost factors, one is wage costs and the other is

The estimated equation showing the above relationship is shown below:

$R^2 = 0.9989$ $R^{-2} = 0.9987$ $DW = 1.71$ $SEE = 1.01$ $RHO = 0.29$
1972 - 1986

CPI = Edmonton consumer price index, 1981 = 100
 WR₍₋₁₎ = Edmonton weekly wage earnings of previous year, in dollars
 ISP₍₋₁₎ = Canadian industry product price index, lagged one year, 1981 = 100
 GDP = Alberta gross domestic product, in 1971 billions of dollars.

The rate of increase of the consumer prices (CPIR) can be calculated by the following formula:

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B. Alberta GDP Implicit Price

The Alberta GDP implicit price is also subject to the "demand pulled" and the "cost pushed" effects. The demand pulled factor can be represented by the real personal disposable income per person. A higher personal disposable income leads to a higher demand for both consumer goods and investment goods which will result in a higher price for both goods.

The "cost pushed" factor can be represented by the Canadian industry product prices. A rise in the industry product prices will increase the costs of production and finally lead to a higher price in the Alberta GDP.

The above relationship is estimated and represented by the following equation:

$$\text{GDPIP} = -96.51 + 3.6656 * \text{ISP}(-1) + 0.0107 * \text{RPDY}$$

(3.44) (23.43) (2.61)

$$R^2 = 0.9966 \quad R^{-2} = 0.9959 \quad DW = 1.90 \quad SEE = 7.11 \quad 1972 - 1986$$

Where:

GDPIP = Alberta GDP implicit price index, 1971 = 100
ISP (-1) = Canadian industry product price index, lagged one year
RPDY = Percent increase of Alberta personal disposable income per person.

The equation shows that both the real personal disposable income and the Canadian industry product prices explained 99.7% of the variation in the Alberta GDP implicit price over the period 1972 to 1986.

C. Canadian Industry Product Prices

Similarly, the Canadian industry product prices are determined by the demand and cost factors. The demand factors are represented by the wage earnings and

the Canadian general economic conditions. The wage earnings, at the same time, exert upward pressure on the industry product prices through the cost factor. For convenience, the Edmonton wage variable, instead of the Canadian wage variable, is used in the equation. Another cost factor is interest rates. A higher interest rates increase carrying charges to the industries and raise the total cost of industrial output. Therefore, all the three factors have a positive impact on the industry product prices. These relationships are shown in the following estimated equation:

$$\text{ISP} = 0.2649 * \text{WR} + 0.4470 * \text{RIR} + 0.4063 * \text{GDPCR}_{(-1)}$$

(70.81) (2.49) (2.76)

$$R^2 = 0.9973 \quad R^{-2} = 0.9968 \quad DW = 1.83 \quad SEE = 1.56 \quad 1972 - 1986$$

Where:

ISP = Canadian industry product price index, 1971 = 100
 WR = Edmonton average weekly wage earnings, in dollars
 RIR = Prime interest rates deflated by consumer price index, in percent
 GDPCR = Growth rate of Canada GDP, in percent.

This equation shows that 99.7% of the increases in the Canadian industry product prices were caused by the combined forces of increases in wage rates, real interest rates and Canada gross domestic product.

The rate of increase of the Canadian industry product prices (ISPR) can be determined by the following formula:

$$\text{ISPR} = (\text{ISP}/\text{ISP}_{(-1)} - 1) * 100$$

D. New Housing Price

The demand factor which affects the new housing price is the unemployment rate. A lower rate of unemployment is expected to associate with a higher demand for new houses which will pull up the new housing price. Interest rates

are also expected to have an impact on the demand for housing. When interest rates rise, demand for housing drops, resulting in a low housing price. On the other hand, higher interest rates increase carrying charges for builders and, therefore, bring up the housing price. The net effect of interest rates on the new housing price depends on the magnitudes of these two conflicting forces in the particular economic conditions.

As in other price behaviors, the Canadian industry product price have a positive impact on the new housing price through the cost-pushed mechanism. Higher prices for construction materials definitely will eventually reflect in a rise in the new housing price.

Inflationary expectations during a period of high inflation exert a significant influence on the price advance. This price spiral effect is especially significant in a speculative market such as the real estate market. The inflation expectation is reflected in the price level of previous year.

The following estimated equation represents the relationship between the new housing price and all the four factors discussed above.

$$\begin{aligned} \text{NHP} = & 16.606 + 0.6219 * \text{NHP}(-1) + 0.4321 * \text{ISP}(-1) \\ & (11.03) \quad (10.46) \quad (5.81) \\ & - 1.5768 * \text{RMR}(-1) - 1.7282 * \text{UR} \\ & (4.39) \quad (5.42) \end{aligned}$$

$$R^2 = 0.9950 \quad R^{-2} = 0.9930 \quad DW = 1.95 \quad SEE = 1.77 \quad 1972 - 1986$$

Where:

NHP =	Edmonton new housing price index, 1981 = 100
NHP (-1) =	Edmonton new housing price index, lagged one year.
ISP (-1) =	Canadian industry product price index, lagged one year 1981 = 100
RMR (-1) =	Real mortgage rate, lagged one year, in percent
UR =	Edmonton unemployment rate, in percent

The four factors together accounted for 99.5% of the increase in the new housing price during the period 1972 to 1986.

The rate of increase in the new housing price (NHPR) can be calculated by the following formula:

$$\text{NHPR} = (\text{NHP} / \text{NHP}_{(-1)} - 1) * 100$$

The real new housing price is the nominal new housing price deflated by the consumer price index, that is,

$$\text{RNHP} = \text{NHP} / \text{CPI} * 100$$

Where:

RNHP =	Real new housing price index, 1981 = 100
NHP =	Nominal new housing price index, 1981 = 100
CPI =	Edmonton consumer price index, 1981 = 100

E. World Oil Price

The world oil price data used in the model is the Chicago price for the West Texas intermediate crude oil. It is treated as exogenous to the model, that is, it is not determined within the model, but is given as an input to the model. The real oil price is the nominal oil price deflated by Alberta GDP implicit price index, that is,

$$\text{RWOP} = \text{WOP} / \text{GDPIP} * 100$$

Where:

RWOP =	Real world oil price, in U.S. dollars per barrel
WOP =	Nominal world oil price, in U.S. dollars per barrel
GDPIP =	Alberta GDP implicit price index, 1971 = 100

F. Interest Rates and Mortgage Rates

The nominal prime lending rate is also treated as exogenous to the model. The real prime lending rate is the difference between the nominal prime lending rate and the inflation rate as measured by the consumer price index, that is,

$$RIR = IR - CPIR$$

Where:

RIR =	Real prime lending rate, in percent
IR =	Nominal prime lending rate, in percent
CPIR =	Inflation rate as measured by consumer prices, in percent

The mortgage rate is expected to follow the same trend as the short term prime lending rate. The relationship between these two rates is estimated as follows:

$$MR = 4.656 + 0.2330 * IR + 0.4509 * IR_{(-1)}$$

(10.25) (3.87) (8.15)

$$R^2 = 0.9444 \quad R^{-2} = 0.9343 \quad DW = 1.98 \quad SEE = 0.67 \quad RHO = -0.44$$

1972 - 1986

Where:

MR =	5-year mortgage rate, in percent
IR =	Prime lending rate, in percent
IR ₍₋₁₎ =	Prime lending rate, lagged one year, in percent

The real mortgage rate (RMR) is defined as the difference of the nominal mortgage rate and the inflation rate, that is,

$$RMR = MR - CPIR$$

8. Edmonton Housing Market

The Edmonton housing market is segregated into single-family housing which includes single detached houses and duplexes, and multiple-family housing which includes row houses and apartment buildings. Within each group, housing starts, completions and absorptions are discussed in this section.

A. Single Family Housing Starts

As discussed in a previous paper An Edmonton Housing Market Model (Huang and Higgins, November 1986), starts are influenced by three main factors: real mortgage rates, real new house prices and the inventory of new houses. Higher real mortgage rates are expected to lower the number of housing starts by reducing effective demand and supply because of higher costs to consumers and producers. Conversely, lower real mortgage rates are expected to stimulate starts by increasing effective demand and supply.

Rising real new house prices are expected to stimulate starts for several reasons. Firstly, on the demand side, rising real prices enhance housing's attractiveness as an investment. Rising prices also prompt demand for housing because of the higher cost to the consumer implied by delaying the purchase of housing. This reflects the inflation expectation effect on housing demand. Rising house prices also give greater profit to the builder, thus stimulating the supply side. It is expected that a high inventory of newly completed single family houses will depress starts because of the associated high carrying costs.

The results of statistically estimating and testing the above relationship are shown below:

$$SS = -174.51 * RMR_{(-1)} + 44.2466 * RNHP_{(-2)} - 0.7650 * SI_{(-1)}$$

(6.37) (23.52) (3.51)

$$R^2 = 0.8259 \quad R^{-2} = 0.7911 \quad DW = 2.43 \quad SEE = 524 \quad RHO = -0.65$$

1973 - 1986

Where:

- SS = Single family housing starts
- RMR (-1) = 5-year mortgage rate adjusted for inflation, lagged one year, in percent
- RNHP (-2) = New housing price index deflated by the consumer price index, lagged two years, 1981 = 100
- SI (-1) = Inventory of newly completed and unoccupied single family houses, lagged one year.

The above equation reflects that the three factors accounted for 83% of the changes in the single family housing starts during 1973-1986.

B. Single Family Housing Completions

Completions of single family houses are determined mainly by housing starts in the current year and in the previous year. Housing starts are the major factor influencing completions because the cost of starting a single family house is high and the building must be finished before the builder's investment can be recouped.

The estimated equation of the above relationships are shown below:

$$SC = 0.4631 * SS + 0.5482 * SS_{(-1)}$$

(4.21) (5.00)

$$R^2 = 0.8789 \quad R^{-2} = 0.8679 \quad DW = 1.91 \quad SEE = 411 \quad 1973 - 1986$$

Where:

- SC = Single family housing completions
- SS = Single family housing starts
- SS (-1) = Single family housing starts of previous year.

The above equation indicates that 46% of houses started in a year are completed in the same year while 54% of them are completed during the following year. Starts are the single most important factor determining completions.

C. Single Family Housing Absorptions

Absorption refers to the occupation of a newly-completed dwelling unit. The model hypothesizes that single family housing completions and annual population change are the main determinants of single family housing absorptions. A higher level of completions increased the supply of houses, thus providing more choice for potential buyers and raising demand during an economic boom time. During a recession period, houses are built only to order to eliminate the expense of carrying a costly inventory of newly-completed dwellings. Thus, nearly all single family housing completions are absorbed (a few newly-completed houses are held as show homes). Large population increases strengthen the demand for housing and push up housing absorptions.

The estimated results of the above relationships are shown below:

$$SA = 501.47 + 0.7431 * SC + 22.129 (POPE - POPE_{(-1)})$$

(3.47) (17.26) (4.53)

$$R^2 = 0.9671 \quad R^{-2} = 0.9606 \quad DW = 2.39 \quad SEE = 185 \quad RHO = -0.21$$

1973 - 1986

Where:

SA = Single family housing absorptions
 SC = Single family housing starts
 POPE = Edmonton population, in thousands of persons
 POPE₍₋₁₎ = Edmonton population of previous year, in thousands of persons

The above equation indicates that 96.7% of the changes in the single family housing absorptions were attributable to the single family housing completions and the Edmonton population increase over the period 1973 to 1986.

D. Single Family Housing Inventory

By definition, inventory for the current year is equal to inventory for the previous year plus new housing completions minus housing absorptions for the year, that is,

$$SI = SI_{(-1)} + SC - SA$$

Where:

SI =	Single family housing inventory
SI ₍₋₁₎ =	Single family housing inventory of previous year
SC =	Single family housing completions
SA =	Single family housing absorptions.

E. Total Housing Starts

As with single housing starts, real mortgage rates and real new housing prices are variables which have a strong influence on the total number of housing starts. These variables influence total starts in the same manner as single starts. The apartment vacancy rate affects total housing starts as well. High vacancy rates discourage investment in apartment housing construction because of the likelihood of low investment returns, whereas low vacancy rates encourage apartment starts. The estimated equation is shown below:

$$TS = -363.37 * RMR - 466.57 * APTVR_{(-1)} + 110.83 * RNHP_{(-2)}$$

(2.73) (3.77) (22.04)

$$R^2 = 0.9235 \quad R^{-2} = 0.9082 \quad DW = 2.19 \quad SEE = 1235 \quad RHO = -0.31$$

1973 - 1986

Where:

TS = Total housing starts

RMR = 5 year mortgage rate adjusted for inflation, in percent

APT_{VR (-1)} = Apartment vacancy rate, lagged one year, in percent

RNHP₍₋₂₎ = New housing price index deflated by the consumer price index, lagged two years.

The equation indicates that the three explanatory variables accounted for 92.4% of the total variation of total housing starts between 1972 and 1986.

F. Total Housing Completions

As with single family housing completions, the main variables determining total housing completions are total starts in the current year and total starts in the previous year. The estimated equation is shown below:

$$TC = 0.3643 * TS + 0.6322 * TS_{(-1)}$$

(3.76) (6.59)

$$R^2 = 0.9471 \quad R^{-2} = 0.9423 \quad DW = 1.99 \quad SEE = 930 \quad RHO = 0.08$$

1973 - 1986

Where:

TC = Total housing completions

TS = Total housing starts

TS₍₋₁₎ = Total housing starts of previous year.

The equation shows that approximately 36% of total dwelling units completed in a year were started in the same year, while the balance were started one year earlier.

G. Total Housing Absorptions

Absorption of total dwelling units is influenced by total completions and the population change of the previous year. These variables act in the same manner as the variable for single family housing absorption. The estimated equation is shown below:

$$TA = 615.69 + 0.7871 * TC + 65.706 * (POPE - POPE_{(-1)})$$

(2.96) (26.34) (5.48)

$$R^2 = 0.9861 \quad R^{-2} = 0.9833 \quad DW = 2.40 \quad SEE = 450 \quad RHO = -0.49$$

1973 - 1986

Where:

TA = Total housing absorptions
TC = Total housing completions
POPE = Edmonton population, in thousands of persons
POPE₍₋₁₎ = Edmonton population of previous year, in thousands of persons.

The equation indicates that 98.6% of the change in the total housing absorptions were contributed by the total housing completions and the Edmonton population increase.

H. Multiple Family Housing Starts

By definition, multiple family housing starts are the difference between total housing starts and single family housing starts, that is,

$$MS = TS - SS$$

Where:

MS = Multiple family housing starts
TS = Total housing starts
SS = Single family housing starts.

I. Multiple Family Housing Completions

Similarly, multiple family housing completions are the difference between total housing completions and single family housing completions, that is,

$$MC = TC - SC$$

Where:

MC = Multiple family housing completions
TC = Total housing completions
SC = Single family housing completions.

J. Multiple Family Housing Absorptions

Multiple family housing absorptions are obtained by subtracting single family housing absorptions from total housing absorptions, that is,

$$MA = TA - SA$$

Where:

MA = Multiple family housing absorptions
TA = Total housing absorptions
SA = Single family housing absorptions.

K. Apartment Vacancy Rates

Apartment vacancy rates are influenced primarily by three variables, the unemployment rate, the number of multiple family completions in the previous year and the vacancy rate in the previous year.

During a period of high unemployment rates, out-migration tends to exceed in-migration, resulting in a loss of population and a decline in housing demand.

As a result, apartment vacancy rates go up. During a period of low unemployment rates, a positive net migration brings about an increase in population and a rise in housing demand. Apartment vacancy rates decline, as a result. Furthermore, apartments are occupied primarily by persons in younger age groups whose housing requirements are more flexible than older age groups. High unemployment rates affect the younger age groups particularly heavily, prompting individuals to reduce housing costs by sharing accommodation or postponing leaving home. Conversely, low unemployment rates lower the vacancy rate because a larger number of persons can afford a higher level of housing.

Completions of multiple family housing units (which include apartments), increase vacancy rates by increasing supply of apartment units. The vacancy rate lagged one year is a trend variable. The estimated equation is shown below:

$$\text{APTVR} = -4.03 + 0.6508 * \text{UR} + 0.0004 * \text{MC}_{(-1)} + 0.2664 * \text{APTVR}_{(-1)}$$

(4.61) (6.38) (3.59) (2.34)

$$R^2 = 0.9203 \quad R^{-2} = 0.8964 \quad DW = 1.69 \quad SEE = 1.07 \quad 1973 - 1986$$

Where:

- APTVR = Apartment vacancy rates
 UR = Edmonton unemployment rates
 MC₍₋₁₎ = The number of multiple family units completed in the previous year
 APTVR₍₋₁₎ = Apartment vacancy rates, lagged one year.

The equation indicates that the three explanatory variables accounted for 92% of the total variation of the apartment vacancy rate between 1973 and 1986.

9. Edmonton Downtown Office Space Market

A. Net New Construction

Net new construction of office space is expected to be influenced by a number of variables such as the previous year's office vacancy rates, the amount of net new construction in the previous years and employment levels.

Office vacancy rates in previous years are expected to influence the current year's level of net new construction. When office vacancy rates are high, little new office construction is likely to occur so that the expected relationship between net new construction and vacancy rates is negative. Previous years' levels of construction activity are expected to influence net new construction activity this year. High levels of construction activity in previous years are likely to lead to reduced levels in the current year and vice versa. An increasing work force is assumed to place more demand for new office space; therefore, a positive relationship is expected between employment levels and net new construction.

The relationships described above are estimated and the resulted equation is shown below:

$$\begin{aligned} \text{NC} = & -1109.2 - 0.974 * \text{NC}_{(-1)} - 0.2645 * \text{NC}_{(-2)} + 11.159 * \text{EMPE}_{(-2)} \\ & (2.68) \quad (6.52) \quad (2.11) \quad (6.17) \\ & - 84.526 * \text{VR}_{(-2)} \\ & (7.29) \end{aligned}$$

$$R^2 = 0.8940 \quad R^{-2} = 0.8410 \quad DW = 2.06 \quad SEE = 230 \quad RHO = -0.02$$

1973 - 1986

Where:

NC = Net new office construction, in thousands of square feet
NC₍₋₁₎ = Net new office construction of previous year
NC₍₋₂₎ = Net new office construction two years ago
EMPE₍₋₂₎ = Edmonton total employment two years ago, in thousands of persons
VR₍₋₂₎ = Office vacancy rate two years ago, in percent.

The equation shows that the four explanatory factors accounted for 89.4% of the variation of the net office construction over the period 1973 - 1986.

B. Total Office Space

Total office space is determined by the total office space in the previous year and the net new office construction in the current year. The estimated relationship is shown as follows:

$$\text{TSO} = 0.9969 * \text{TSO}_{(-1)} + 1.2233 * \text{NC}$$

(99.58) (10.99)

$$R^2 = 0.9949 \quad R^{-2} = 0.9945 \quad DW = 1.82 \quad SEE = 263 \quad RHO = -0.18$$

1973 - 1986

Where:

TSO = Total office space, in thousands of square feet
TSO₍₋₁₎ = Total office space of previous year
NC = Net new office construction, in thousands of square feet.

The equation displays that 99.5% of the change in the total office space were contributed by the two explanatory variables.

C. Office Space Absorption

The variables which are expected to have influence on office space absorption include the National Energy Program, world oil prices, new office construction and the previous year's absorption of office space. The estimated relationship is shown below:

$$\begin{aligned} \text{ABSOF} = & -0.2565 * \text{ABSOF}_{(-1)} - 897.68 * \text{NEP} + 0.2964 * \text{NC}_{(-1)} \\ & (2.16) \qquad \qquad (8.02) \qquad \qquad (4.19) \\ & + 80.148 * \text{RWOP} \\ & (8.17) \end{aligned}$$

$$R^2 = 0.8779 \quad R^{-2} = 0.8413 \quad DW = 2.1 \quad SEE = 139 \quad RHO = 0.10$$

1972 - 1986

Where:

ABSOF = Office space absorption, in thousands of square feet
ABSOF₍₋₁₎ = Office space absorption of previous year
NEP = National Energy Program; 1 for the years in which the NEP program is in effect, 0 for other years
NC₍₋₁₎ = Net new office construction of previous year, in thousands of square feet.

The equation indicates that the three factors accounted for 87.8% of the variation of the office space absorption during the period 1972 to 1986.

D. Total Occupied Office Space

Total occupied office space is determined by the total occupied space of the previous year and the office space absorption in the current year. The relationships are estimated as below:

$$TO = 1.0485 * TO_{(-1)} + 0.4778 * ABSOF$$

(86.43) (3.11)

$$R^2 = 0.9843 \quad R^{-2} = 0.9830 \quad DW = 2.65 \quad SEE = 332 \quad RHO = -0.64$$

1972 - 1986

Where:

TO = Total occupied office space, in thousands of square feet
TO₍₋₁₎ = Total occupied office space of previous year
ABSOF = Office space absorption, in thousands of square feet.

The equation shows that the two explanatory variables accounted for 98.4% of the variation in the total occupied office space over the period 1972 to 1986.

E. Office Vacancy Rates

The office vacancy rate can be calculated from the following formula:

$$VR = (TSO - TO) / TSO * 100$$

Where:

VR = Office vacancy rates, in percent
TSO = Total office space, in thousands of square feet
TO = Total occupied office space, in thousands of square feet.

Alternatively, the office vacancy rate can be estimated based on a causal relationship. The office vacancy rate is related to the vacancy rate in the

previous year, the net new construction and the office space absorption rate. The estimated results are presented as follows:

$$VR = 0.9510 * VR_{(-1)} + 0.0084 * NC - 0.0076 * ABSOF$$

(31.91) (14.53) (9.88)

$$R^2 = 0.9677 \quad R^{-2} = 0.9618 \quad DW = 2.32 \quad SEE = 1.69 \quad RHO = -0.677$$

1972 - 1986

Where:

VR = Office vacancy rates, in percent
 VR₍₋₁₎ = Office vacancy rates of the previous year
 NC = Net new construction, in thousands of square feet
 ABSOF = Office space absorption, in thousands of square feet.

The above equation shows that 96.8% of the variation in the office vacancy rate were contributed by the vacancy rate of the previous year, the net new construction and the office space absorption over the period 1972 - 1986.

10. Edmonton Construction Sector

The level of construction activity reflects in the value of building permits. The building permits can be grouped into residential building permits and commercial and industrial building permits. While some socio-economic factors may affect the activity level of both groups, other factors may influence only one group but not the other. For instance, the size of net migration affects demands for both residential and commercial properties which determines the level of construction activity in both groups of properties. The apartment vacancy rate is expected to affect the residential construction activity, while the office space vacancy rate is expected to influence the commercial construction activity.

A. Total Building Permit Values

The total building permit value is expected to be determined by the total building permit value in the previous year, the office space absorption rate and the apartment vacancy rate in the previous year. The building permit value in the previous year is expected to have a positive effect on the building permit value of the current year because some projects, especially for commercial buildings and large apartment buildings, started in the previous year are carried over into the current year. The rate of office space absorption affects the decision to start a new commercial construction project and therefore has positive impact on the building permit value. Conversely, the apartment vacancy rate has a negative impact on the building permit value for residential buildings. The estimated relationship for the period 1973 to 1986 is shown below:

$$\begin{aligned} \text{BPTR} = & 146.446 + 0.6001 * \text{BPTR}_{(-1)} + 0.4116 * \text{ABSOF} \\ & (2.02) \quad (9.00) \quad (9.48) \\ & - 20.1118 * \text{APTVR}_{(-1)} \\ & (3.44) \end{aligned}$$

$$R^2 = 0.9755 \quad R^{-2} = 0.9673 \quad DW = 2.0 \quad SEE = 51.36 \quad RHO = -0.21$$

1973 - 1986

Where:

BPTR = Total building permit value, in millions of 1981 dollars
BPTR₍₋₁₎ = Total building permit value of previous year
ABSOF = Office space absorption, in thousands of square feet
APTVR₍₋₁₎ = Apartment vacancy rate of previous year, in percent.

The equation indicates that 97.6% of the changes in the total building permit value were attributable to the three explanatory variables over the period 1973 to 1986.

The total building permit values in nominal dollars (BPT) are the product of the total building permit values in 1981 dollars (BPTR) and the price as measured by CPI, that is,

$$BPT = BPTR * CPI / 100$$

B. Residential Building Permit Values

The residential building permit values are expected to be influenced by net migration, mortgage rates, apartment vacancy rates and employment. While net migration and employment have a positive relationship with the residential building permit values, the mortgage rates and apartment vacancy rates have a negative relationship with the residential building permit values. The estimated results of these relationships are presented as follows:

$$\begin{aligned} BPRR = & 393.53 + 18.1781 * MIGNE - 24.037 * MR \\ & (2.27) \quad (2.65) \quad (1.68) \\ & + 32.9349 * APTVR (-1) + 0.9678 * EMPE (-1) \\ & (3.28) \quad (1.24) \end{aligned}$$

$$R^2 = 0.86 \quad R^{-2} = 0.79 \quad DW = 1.63 \quad SEE = 87.16 \quad RHO = -0.01$$

1973 - 1986

Where:

BPRR = Residential building permit values, in millions of 1981 dollars
MIGNE = Edmonton net migration, in thousands of persons
MR = 5-year mortgage rates, in percent
APTVR (-1) = Apartment vacancy rates of the previous year, in percent
EMPE (-1) = Edmonton total employment of the previous year, in thousands of persons.

The equation shows that 86% of the variation in the residential building permit values were explainable by the four factors during the period 1973 to 1986.

The residential building permit value in nominal dollars (BPR) is the product of its value in 1981 dollars (BPRR) and the price as measured by CPI, that is,

$$BPR = BPRR * CPI / 100$$

C. Commercial/Industrial Building Permit Values

The commercial/industrial building permit values are expected to be affected by net migration, employment level, Alberta economic growth rate and office space vacancy rates. A higher net migration and employment lead to a higher demand for commercial and industrial space which generates more construction activity for the sector. Similarly, higher economic growth is expected to bring about higher investment in the construction sector. On the other hand, higher office space vacancy rates tend to discourage investors from putting more money in the commercial real estate, resulting a lower construction activity.

The above relationships are tested and the estimated equation is shown below:

$$BPCR = 14.3304 * MIGNE + 1.1305 * EMPE_{(-1)} + 7.3677 * GDPR_{(-1)} - 3.7087 * VR_{(-1)}$$

(4.12) (8.09) (1.60) (1.39)

$$R^2 = 0.8498 \quad R^{-2} = 0.8047 \quad DW = 1.97 \quad SEE = 56.8 \quad 1973 - 1986$$

Where:

BPCR =	Commercial building permit values, in millions of 1981 dollars
MIGNE =	Edmonton net migration, in thousands of persons
EMPE ₍₋₁₎ =	Edmonton total employment of previous year, in thousands of persons
GDPR ₍₋₁₎ =	Alberta GDP growth rate of previous year, in percent
VR ₍₋₁₎ =	Edmonton office space vacancy rates of previous year, in percent.

The equation shows that the four factors accounted for 85% of the variation of the commercial/industrial building permit values during the 1973 - 1986 period.

Alternatively, the commercial/industrial building permit values can be derived from the following formula:

$$BPCR = BPTR - BPRR$$

Where:

BPCR = Commercial/industrial building permit values

BPTR = Total building permit values

BPRR = Residential building permit values.

The commercial/industrial building permit values in nominal dollars (BPC) can be calculated from the following formula:

$$BPC = BPCR * CPI / 100$$

11. Edmonton Retail Market

This section deals with Edmonton retail sales. Retail sales are expected to be influenced by consumer prices, personal disposable incomes and the level of economic activity. Higher consumer prices tend to dampen demand for consumer goods, resulting in a lower volume of sales. Conversely, higher personal disposable incomes generate higher demand for consumer goods which translates to higher volume of sales. Likewise, higher rates of economic growth are expected to generate higher volumes of retail sales.

The above relationships are tested and the resulted equation is shown below:

$$RSAL81 = -2605.9 - 28.445 * CPI + 0.616 * RPDY + 253.49 * GDP$$

(3.68) (5.67) (2.60) (1.64)

$$R^2 = 0.9372 \quad R^{-2} = 0.9201 \quad DW = 1.66 \quad SE = 195.35 \quad 1971 - 1985$$

Where:

RSALE81 = Edmonton retail sales, in millions of 1981 dollars
CPI = Edmonton consumer price index, 1981 = 100
RPDY = Per capita personal disposable income for Alberta, in 1971 dollars
GDP = Alberta gross domestic product, in billions of 1971 dollars

The above equation indicates that 93.7% of the variation in the volume of retail sales in Edmonton were attributable to consumer prices, per capita disposable income and the general economic condition in Alberta.

The retail sales in nominal dollars (RSALE) can be calculated by the following formula:

$$\text{RSALE} = \text{RSALE81} * \text{CPI} / 100$$

12. Edmonton Industrial Activity

The detailed description of modelling the economic activity by industry division and the estimated equations can be found in the research paper An Econometric Model of the Edmonton Economy: Output, Employment and Wage Modules (Research Paper No. 7, Edmonton Planning and Development Department, October 1986). This sub-model of industrial activity is not included in the simulation discussed in the next section.

IV. SIMULATION OF THE MODEL

The estimated model described in the previous section and presented in Appendix II was used to simulate the impact of different oil prices on the Alberta and Edmonton economies, using the Econometric software Package (ESP). This section presents the assumptions used in the simulation and the simulated results for each of the two oil price scenarios.

1. Assumptions Used in Model Simulation

Two different assumptions are made for the world oil prices and one common set of assumptions are used for other exogenous variables such as interest rates, Canada economic growth rate and Canada unemployment rate. The high oil price scenario assumes that the oil price will average US\$18 per barrel in 1989 and increase US\$2 per year to reach US\$28 in 1994. This assumption is similar to the one adopted by the City Forecast Committee in their January 26, 1989 report Socio-economic Forecasts, 1989 - 1994, City of Edmonton - Summary Report. The low oil price scenario assumes the oil price for West Texas intermediate crude at Chicago will stay at US\$16 per barrel throughout the forecast period. The following table lists the assumptions made for each of the exogenous variables over the period 1988 to 1994.

	World Oil Prices			Canada GNP Growth (%)	Canada Unemployment Rate (%)	% Female Age 15 + (%)
	Low Price (US \$/barrel)	High Price (US \$/barrel)	Prime Rate (%)			
1988	16	16	10.80	4.2	7.8	49.5
1989	16	18	12.00	2.5	7.7	49.6
1990	16	20	10.50	2.0	7.6	49.7
1991	16	22	9.50	3.0	7.5	49.8
1992	16	24	9.25	3.0	7.4	49.9
1993	16	26	9.00	3.0	7.3	50.0
1994	16	28	9.00	3.5	7.2	50.0

2. Simulated Results

The simulated results for the high oil price scenario are shown in Appendix III and those for the low oil price scenario are displayed in Appendix IV. Comparison of the two different simulated results is shown in Appendix V. The simulated values for some of the major variables in the model are briefly discussed below.

Under the high oil price scenario, the Alberta economy is expected to expand approximately by 3% in 1989 and 4% per year over 1990 - 1994. Alberta unemployment rate will fall continually from 8.3% in 1989 to 5.9% in 1994. As a result, net migration to Alberta will rise from about 8,000 in 1989 to 25,000 in 1994. Edmonton employment will grow at a rate of 4.2% per year from 386,000 in 1989 to 475,000 in 1994, resulting in a drop in the unemployment rate from 9.3% in 1989 to 6.5% in 1994. Consumer prices in Edmonton will fluctuate within a narrow range of 3.7% to 5.0% and weekly wage earnings will increase at a marginally higher rate than inflation at 4.2% to 5.4% during the forecast period. The apartment vacancy rate is expected to decline steadily from 4.5% in 1989 to 2.5% in 1994 while the downtown office space vacancy rate will remain around 15% during the same period. There will be a total of 2,800 housing starts in 1989, increasing to 4,600 starts in 1994, of which single family housing starts will account for 2,400 units and 3,000 units. The value of building permits will increase by 15% per year from \$480 million in 1989 to \$960 million in 1994. Edmonton retail sales are expected to increase at an average rate of about 10% per year from \$6.0 billion in 1989 to \$9.6 billion in 1994.

Under the low oil price scenario, the economic performance in Alberta and Edmonton will not be as bright as the high oil price case. However, the Alberta economy is still expected to have a moderate growth rate of 2.5% to 3.5% over the forecast period. This indicates that the increasingly diversified structure of the Alberta economy have reduced the adverse impact of the lower world oil price and have made the local economy more stable. Alberta unemployment rate will drop more slowly from 8.4% in 1989 to 6.6% in 1994; as a consequence, there will be a lower rate of net migration to Alberta at 5,000 in 1989 and 10,000 in 1994. Edmonton will also have a slightly higher rate of unemployment at 9.5% in 1989, falling to 7.7% in 1994, because total

employment in Edmonton is expected to grow at a lower rate of 2.9% per year over the same period. Because of the expected slower activities in the economy, consumer prices will increase at a lower rate of 3.2% to 4.8% and wage rates will rise at 3.4% to 5.0% during the period. The apartment vacancy rate is forecast to decline marginally from 4.6% in 1989 to 3.4% in 1994, while the downtown office space vacancy rate is to remain above 15% throughout the period. Total housing starts will only increase 6.3% per year from 2,800 units in 1989 to 3,800 units in 1994, of which single family housing starts account for 2,400 units and 2,700 units. The value of building permits will only go up by 8.3% per year from \$450 million in 1989 to \$670 million in 1994. Retail sales in Edmonton are expected to increase at an annual rate of 7.8% from \$5.9 billion in 1989 to \$8.6 billion in 1994.

V. CONCLUSIONS AND RECOMMENDATIONS

The Edmonton Econometric Model described in the previous sections has met the objectives set out for the project. Most importantly, the model enables users to evaluate the impact of changes in world oil prices and other external factors on the Alberta and Edmonton economies. Although there is a need for further enhancements in the future, this model will continue to be used by the Forecasting and Policy Development Group of the City Planning and Development Department to assist the City Forecast Committee and various civic departments in their preparation of five-year economic forecasts for the City's annual budget and planning, and for impact analyses of external factors on provision of municipal services.

This model should be updated and refined annually to utilize newly available data in order to reflect possible structural changes in the economy and to incorporate in the model new policy variables such as Federal and Alberta oil and gas royalty taxes and incentives. A second recommendation is that the model be expanded to include public and private investment variables for the purpose of evaluating the impact of major investment project announcements on the provincial and local economies. This objective may be achieved by incorporating the Alberta input-output model in the Edmonton Model.

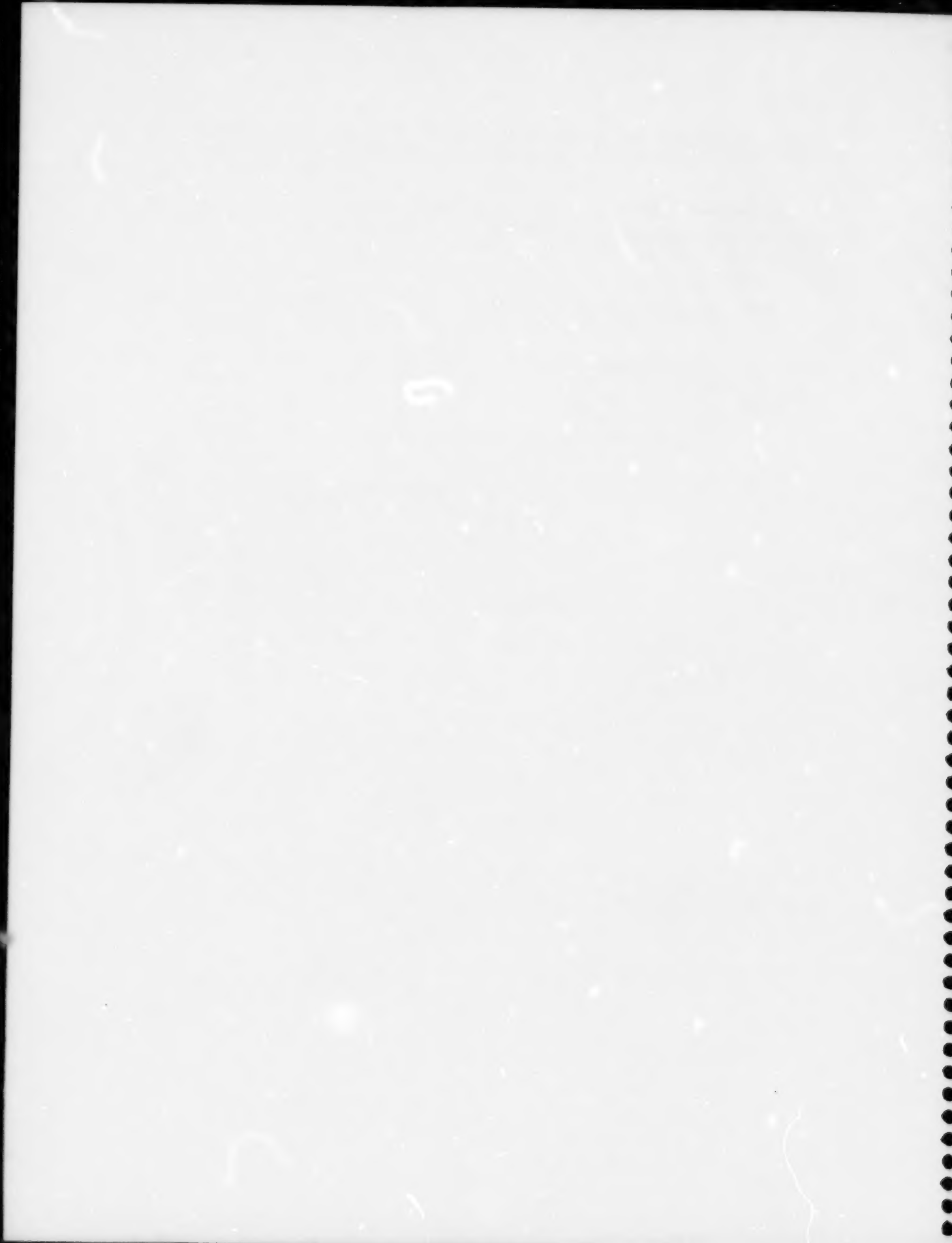
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APPENDICES



APPENDIX I

LIST OF VARIABLES USED IN THE EDMONTON ECONOMETRIC MODEL

I. EXOGENOUS VARIABLES

FWAP	- Percent of working age population accounted for by female
IR	- Prime lending rate, in percent
NEP	- National Energy Program, a dummy variable
RGNP	- Canada gross national product growth rate, in percent
TIME	- Year used as a proxy for time trend
URC	- Canada unemployment rate, in percent

II. ENDOGENOUS VARIABLES

ABSOF	- Office space absorption, in thousands of square feet
APTVR	- Apartment vacancy rate, in percent
BPC	- Commercial/industrial building permit values, in millions of dollars
BPCR	- Commercial/industrial building permit values, in millions of 1981 dollars
BPR	- Residential building permit values, in millions of dollars
BPRR	- Residential building permit values, in millions of 1981 dollars
BPT	- Total building permit values, in millions of dollars
BPTR	- Total building permit values, in millions of 1981 dollars
CPI	- Edmonton consumer price index, 1981 = 100
CPIR	- Edmonton inflation rate, in percent
EMPA	- Alberta employment, in thousands of persons
EMPE	- Edmonton employment, in thousands of persons
GDP	- Alberta gross domestic product, in billions of 1971 dollars
GDPE	- Edmonton gross domestic product, in millions of 1971 dollars
GDPER	- Edmonton gross domestic product growth rate, in percent
GDPIP	- Alberta gross domestic product implicit price index, 1971 = 100
GDPR	- Alberta gross domestic product growth rate, in percent

ISP	- Canada industry product price index, 1981 = 100
ISPR	- Canada industry product price growth rate, in percent
LF	- Edmonton labour force, in thousands of persons
LFA	- Alberta labour force, in thousands of persons
MA	- Multiple housing absorptions
MC	- Multiple housing completions
MIGINA	- Alberta total in-migration, in thousands of persons
MIGINE	- Edmonton total in-migration, in thousands of persons
MIGNA	- Alberta net migration, in thousands of persons
MIGNE	- Edmonton net migration, in thousands of persons
MIGOTA	- Alberta total out-migration, in thousands of persons
MIGOTE	- Edmonton total out-migration, in thousands of persons
MR	- 5 year mortgage rates, in percent
MS	- Multiple housing starts
NC	- New office space construction, in thousands of square feet
NHP	- New housing price index, 1981 = 100
NHPR	- New housing price growth rate, in percent
POPA	- Alberta population, in thousands of persons
POPE	- Metro-Edmonton population, in thousands of persons
PR	- Edmonton labour force participation rate, in percent.
PRA	- Alberta labour force participation rate, in percent
RIR	- Real prime rate, in percent
RMR	- 5 year mortgage rates deflated by consumer price index, in percent
RNHP	- Real new housing price index, 1981 = 100
RPDY	- Alberta real personal disposable income per capita, in 1981 dollars
RPY	- Alberta real personal income per capita, in 1981 dollars
RPYR	- Alberta real personal income growth rate, in percent
RSAL	- Edmonton retail sales, in millions of dollars
RSAL81	- Edmonton retail sales, in millions of 1981 dollars
RWOP	- World oil price deflated by Alberta GDP implicit price index, in 1971 dollars
SA	- Single family housing absorptions
SC	- Single family housing completions
SI	- Single family housing inventory

SS	- Single family housing starts
TA	- Total housing absorptions
TC	- Total housing completions
TO	- Total occupied office space, in thousands of square feet
TS	- Total housing starts
TSO	- Total office space, in thousands of square feet
UR	- Edmonton unemployment rate, in percent
URA	- Alberta unemployment rate, in percent
VR	- Edmonton downtown office vacancy rate, in percent
WAP	- Edmonton working age population, in thousands of persons
WAPA	- Alberta working age population, in thousands of persons
WR	- Edmonton weekly wage earnings for all industries, in dollars
WRA	- Alberta weekly wage earnings for all industries, in dollars
WRAR	- Alberta weekly wage growth rate for all industries, in percent
WRR	- Edmonton weekly wage growth rate for all industries, in percent

APPENDIX II

EQUATIONS OF THE EDMONTON ECONOMETRIC MODEL

ALMIGTIN : $MIGINA = 158.47 - 173.46 \cdot URA/URC + .06441 \cdot EMPA + 3.1606 \cdot GDP - .099772$
 $\quad \cdot (MIGINA(-1) - (158.47 - 173.46 \cdot URA(-1)/URC(-1) + .06441 \cdot EMPA(-1)$
 $\quad + 3.1606 \cdot GDP(-1)))$

ALMIGTOT : $MIGOTA = MIGINA - MIGNA$

ATAMIG : $MIGNA = 77.307 + 2.3346 \cdot GDP(-1) + 2.3066 \cdot GDP - 63.844 \cdot URA(-1)$
 $\quad /URC(-1) - 58.609 \cdot URA/URC + 15.193 \cdot MIGNADUM + .22071 \cdot (MIGNA(-1)$
 $\quad - (77.307 + 2.3346 \cdot GDP(-2) + 2.3066 \cdot GDP(-1) - 63.844 \cdot URA(-2)$
 $\quad /URC(-2) - 58.609 \cdot URA(-1)/URC(-1) + 15.193 \cdot MIGNADUM(-1)))$

BPERCOM : $BPC = BPCR \cdot CPI / 100$

BPERMIT : $BPT = BPTR \cdot CPI / 100$

BPERRES : $BPR = BPRR \cdot CPI / 100$

BUCOM : $BPCR = 14.3304 \cdot MIGNE - 3.7087 \cdot VR(-1) + 1.1305 \cdot EMPE(-1) + 7.3677$
 $\quad \cdot GDP(-1)$

BUILD : $BPTR = 146.45 + .60008 \cdot BPTR(-1) + .4116 \cdot ABSOF - 20.112 \cdot APTVR(-1)$
 $\quad - .2072 \cdot (BPTR(-1) - (146.45 + .60008 \cdot BPTR(-2) + .4116 \cdot ABSOF(-1)$
 $\quad - 20.112 \cdot APTVR(-2)))$

BURES : $BPRR = 393.527 + 18.1781 \cdot MIGNE - 24.0368 \cdot MR - 32.9349 \cdot APTVR(-1)$
 $\quad + .9678 \cdot EMPE(-1) - .013 \cdot (BPRR(-1) - (393.527 + 18.1781 \cdot MIGNE(-1)$
 $\quad - 24.0368 \cdot MR(-1) - 32.9349 \cdot APTVR(-2) + .9678 \cdot EMPE(-2)))$

CAM : $ABSOFF = -.25655 \cdot ABSOFF(-1) - 897.68 \cdot NEP + .29637 \cdot NC(-1) + 80.148 \cdot RWOP$
 $\quad + .096592 \cdot (ABSOFF(-1) - (-.25655 \cdot ABSOFF(-2) - 897.68 \cdot NEP(-1) + .29637$
 $\quad \cdot NC(-2) + 80.148 \cdot RWOP(-1)))$

DEFL : $GDIPI = -96.506 + 3.6656 \cdot ISP(-1) + .010669 \cdot RPDY$

EDEMP : $EMPE = -78.343 + .26401 \cdot EMPE(-1) + 9.7392 \cdot GDP - .42427 \cdot WR + .95773 \cdot LF$
 $\quad + .2848 \cdot (EMPE(-1) - (-78.343 + .26401 \cdot EMPE(-2) + 9.7392 \cdot GDP(-1)$
 $\quad - .42427 \cdot WR(-1) + .95773 \cdot LF(-1)))$

EDMIG : $MIGNE = -12 + .1544 \cdot MIGNA + .0357 \cdot EMPE$

EDMIGTIN : $MIGINE = 6 + .1544 \cdot MIGINA + .0357 \cdot EMPE$

EDMIGTOT : $MIGOTE = MIGINE - MIGNE$

FIFTEEN : $WAP = -81.412 + .88259 \cdot POPE$

GOODS : $CPI = .12054 \cdot WR(-1) + .52395 \cdot ISP(-1) + .9805 \cdot GDP + .29062 \cdot (CPI(-1)$
 $\quad - (.12054 \cdot WR(-2) + .52395 \cdot ISP(-2) + .9805 \cdot GDP(-1)))$

GROWTH : $GDP = (GDP - GDP(-1)) / GDP(-1) \cdot 100$

GROWTHED : $GDPE = (GDPE - GDPE(-1)) / GDPE(-1) \cdot 100$

HOUSE : $NHP = 16.806 + .62192 * NHP(-1) + .43212 * ISP(-1) - 1.5768 * RMR(-1) - 1.7282 * UR$
 INCOME : $GDP = -266.19 + .13605 * TIME - .53854 * NEP + .11341 * RWOP - .032193 * RIR + .008909 * EMPA$
 INCOMEOM : $GOPE = WR * EMPE / (WRA * EMPA) * GDP * 1000$
 INDUST : $ISP = .26486 * WR + .44704 * RIR + .40631 * GDPCR(-1) + .062681 * (ISP(-1) - (.26486 * WR(-1) + .44704 * RIR(-1) + .40631 * GDPCR(-2)))$
 ISPRICE : $ISPR = (ISP / ISP(-1) - 1) * 100$
 JOBED : $EMPA = -149.18 + .7724 * EMPA(-1) + 46.8046 * GDP - .5705 * WRA - .2934 * (EMPA(-1) - (-149.18 + .7724 * EMPA(-2) + 46.8046 * GDP(-1) - .5705 * WRA(-1)))$
 MANP : $UR = 100 * (LF - EMPE) / LF$
 MORTG : $MR = 4.6564 + .23298 * IR + .45091 * IR(-1) - .4411 * (MR(-1) - (4.6564 + .23298 * IR(-1) + .45091 * IR(-2)))$
 MORTGRE : $RMR = MR - CPIR$
 MULTIA : $MA = TA - SA$
 MULTIC : $MC = TC - SC$
 MULTIS : $MS = TS - SS$
 NCONS : $NC = -1109.2 - 84.526 * VR(-2) - .97401 * NC(-1) - .26447 * NC(-2) + 11.159 * EMPE(-2) - .02003 * (NC(-1) - (-1109.2 - 84.526 * VR(-3) - .97401 * NC(-2) - .26447 * NC(-3) + 11.159 * EMPE(-3)))$
 NHPRICE : $NHPR = (NHP / NHP(-1) - 1) * 100$
 OFFSPACE : $TSO = .99691 * TSO(-1) + 1.2233 * NC - .17878 * (TSO(-1) - (.99691 * TSO(-2) + 1.2233 * NC(-1)))$
 OILPRICE : $RWOP = WOP / GDP * 100$
 PARTAL : $PRA = 108.35 + .972 * GDP + .0994 * URA(-1) + 4.50E-4 * RPY(-1) - 1.1507 * FWAP$
 PEOPLE : $POPE = 337.75 + 6.24E-5 * POPA^2 + 95.511 * POPEOM$
 PERSINC : $RPY = 3559.3 + 2.2847 * WR + 19.288 * EMPE + 164.24 * GDP + .27206 * (RPY(-1) - (3559.3 + 2.2847 * WR(-1) + 19.288 * EMPE(-1) + 164.24 * GDP(-1)))$
 POOR : $URA = (LFA - EMPA) / LFA * 100$

POPULA : $POPA = 1.0132 * POPA(-1) + 1.0096 * .5 * (MIGNA + MIGNA(-1))$
 PRICES : $CPIR = (CPI - CPI(-1)) / CPI(-1) * 100$
 PROVLAB : $LFA = PRA * WAPA / 100$
 REAINT : $RIR = IR - CPIR$
 REINCN : $RPDY = 2385.3 + 11.492 * EMPE + 321.6 * GDP + .2089 * (RPDY(-1) - (2385.3 + 11.492 * EMPE(-1) + 321.6 * GDP(-1)))$
 RETRADE : $RSALE81 = -2605.9 - 28.445 * CPI + .61603 * RPDY + 253.49 * GDP$
 RHPRICE : $RNHP = NHP / CPI * 100$
 RINCOME : $RPYR = (RPY / RPY(-1) - 1) * 100$
 SINGLEA : $SA = 501.47 + .74312 * SC + 22.129 * (POPE - POPE(-1)) - .21039 * (SA(-1) - (501.74 + .74312 * SC(-1) + 22.129 * (POPE(-1) - POPE(-2))))$
 SINGLEC : $SC = .46306 * SS + .54817 * SS(-1) - .49633 * (SC(-1) - (.46306 * SS(-1) + .54817 * SS(-2)))$
 SINGLEI : $SI = SI(-1) + SC - SA$
 SINGLES : $SS = -174.51 * RMR(-1) + 44.247 * RNHP(-2) - .76499 * SI(-1) - .65107 * (SS(-1) - (-174.51 * RMR(-2) + 44.247 * RNHP(-3) - .76499 * SI(-2)))$
 SKILLS : $LF = PR * WAP / 100$
 SPACE : $TO = 1.0485 * TO(-1) + .4778 * ABSOF - .63994 * (TO(-1) - (1.0485 * TO(-2) + .4778 * ABSOF(-1)))$
 SVACT : $VR = (TSO - TO) / TSO * 100$
 TOTALA : $TA = 615.69 + .78709 * TC + 65.706 * (POPE - POPE(-1)) - .48799 * (TA(-1) - (615.69 + .78709 * TC(-1) + 65.706 * (POPE(-1) - POPE(-2))))$
 TOTALC : $TC = .36431 * TS + .63223 * TS(-1) + .084165 * (TC(-1) - (.36431 * TS(-1) + .63223 * TS(-2)))$
 TOTALS : $TS = -363.37 * RMR - 466.57 * APTVR(-1) + 110.83 * RNHP(-2) - .3101 * (TS(-1) - (-363.37 * RMR(-1) - 466.57 * APTVR(-2) + 110.83 * RNHP(-3)))$
 TRADE : $RSALE = RSALE81 * CPI / 100$
 VACRATE : $VRR = .95095 * VR(-1) + .008354 * NC - .007634 * ABSOF - .67705 * (VR(-1) - (.95095 * VR(-2) + .008354 * NC(-1) - .007634 * ABSOF(-1)))$
 VRAPT : $APTVR = -4.0274 + .26641 * APTVR(-1) + .65075 * UR + 4.04E-4 * MC(-1)$

WAGALTA : $WRA = 4.1363 \cdot CPI - 8.4384 \cdot URA(-1) - .26126 \cdot (WRA(-1) - (4.1363 \cdot CPI(-1) - 8.4384 \cdot URA(-2)))$
 WAGPRI : $WR = -10.221 + 3.8644 \cdot CPI - 3.8437 \cdot UR(-1) - .43169 \cdot (WR(-1) - (-10.221 + 3.8644 \cdot CPI(-1) - 3.8437 \cdot UR(-2)))$
 WILLWORK : $PR = 38.552 + .21941 \cdot GDPR - .20267 \cdot UR(-1) + .002765 \cdot RPY(-1)$
 WORPOP : $WAPA = -316.82 + .87728 \cdot POPA + .5761 \cdot (WAPA(-1) - (-316.82 + .87728 \cdot POPA(-1)))$
 WRATA : $WRAR = (WRA/WRA(-1) - 1) \cdot 100$
 WRATE : $WRR = (WR/WR(-1) - 1) \cdot 100$

APPENDIX III

SIMULATED RESULTS - HIGH OIL PRICE SCENARIO

ID	ABSOF :S	APTVR :S	BPC :S	BPCR :S	BPR :S
1987	255.972	5.64801	268.446	200.776	181.526
1988	111.050	4.89255	391.902	284.932	248.908
1989	324.526	4.51132	455.721	318.467	297.350
1990	218.180	4.41600	482.474	321.218	325.211
1991	334.503	4.01755	555.059	355.213	421.564
1992	331.027	3.45288	640.657	395.237	550.655
1993	358.345	2.78907	748.286	443.608	698.506
1994	386.162	2.48470	860.216	489.473	854.860

ID	BPRR :S	BPT :S	BPTR :S	CPI :S	CPIR :S
1987	135.767	449.344	336.073	133.704	4.21219
1988	180.968	447.912	325.654	137.542	2.87043
1989	207.794	477.456	333.656	143.098	4.03951
1990	216.517	534.063	355.565	150.201	4.96375
1991	269.782	635.433	406.649	156.280	4.03434
1992	339.713	723.497	446.343	162.094	3.73313
1993	414.097	830.344	492.255	166.681	4.06394
1994	486.426	957.292	544.711	175.743	4.18621

ID	EMPA :S	EMPE :S	GDP :S	GOPE :S	GOPER :S
1987	1151.02	363.971	15.0405	4552.48	7.11408
1988	1186.59	375.457	15.7314	4755.58	4.46120
1989	1223.03	385.666	16.2196	4942.84	3.93768
1990	1268.36	397.580	16.8581	5122.20	3.62860
1991	1324.22	411.984	17.5196	5319.46	3.85119
1992	1385.80	429.687	18.2234	5481.30	3.04246
1993	1453.77	451.304	18.9977	5698.82	3.96830
1994	1527.38	474.662	19.8051	5961.55	4.61022

ID	GDPIP :S	GDPR :S	ISP :S	ISPR :S	LF :S
1987	381.430	2.61156	122.702	2.59405	410.440
1988	396.249	4.58818	128.292	4.55595	413.704
1989	419.593	3.09500	134.873	5.12947	425.168
1990	447.357	3.93167	139.545	3.46395	437.520
1991	468.516	3.91962	144.682	3.68103	450.043
1992	491.921	4.00584	150.832	4.25090	465.501
1993	519.769	4.23757	157.115	4.16526	484.797
1994	548.431	4.23872	164.919	4.96762	507.745

ID	LFA :S	MA :S	MC :S	MIGINA :S	MIGINE :S
1987	1272.90	268.985	245.230	70.2936	29.8471
1988	1297.54	578.822	352.796	74.9375	30.9742
1989	1333.51	1201.03	497.794	78.1179	31.5209
1990	1382.22	1501.90	656.739	80.3049	32.5927
1991	1432.85	1622.65	750.964	96.5472	35.6147
1992	1487.68	1713.63	744.435	115.588	39.1867
1993	1550.47	2106.66	1061.76	133.044	42.6536
1994	1623.00	2516.23	1409.49	144.029	45.1835

ID	MIGNA :S	MIGNE :S	MIGOTA :S	MIGOTE :S	MR :S
1987	-16.9455	-1.62262	87.2392	31.4697	11.0163
1988	8.01088	2.64071	66.9267	28.3334	10.8155
1989	7.65184	2.94973	68.4861	28.5711	11.7045
1990	3.91133	2.79753	76.3936	29.7951	11.8859
1991	6.58283	3.72424	89.9844	31.8905	10.9811
1992	13.3854	5.40657	102.203	33.7801	10.4699
1993	20.7024	7.30803	112.342	35.3456	10.2998
1994	24.8597	8.78379	119.169	36.3997	10.1867

ID	MS :S	NC :S	NHP :S	NHPR :S	POPA :S
1987	204.461	6.39935	89.4693	4.52030	2380.25
1988	393.116	538.399	98.5650	10.1662	2408.13
1989	446.762	315.972	104.759	6.28413	2456.79
1990	786.620	555.617	112.176	7.08095	2514.04
1991	518.935	595.054	121.141	7.99167	2571.50
1992	874.986	650.855	130.216	7.49131	2634.48
1993	1194.58	740.441	140.205	7.67109	2705.42
1994	1601.31	846.772	150.602	7.41492	2783.08

ID	POPE :S	PR :S	PRA :S	RIR :S	RMR :S
1987	786.794	72.8370	72.0047	5.28780	6.80411
1988	795.126	72.4705	72.3688	7.92956	7.94514
1989	809.897	72.8158	72.6297	7.96048	7.66506
1990	827.654	72.9725	73.2693	5.53624	6.92219
1991	845.890	73.0990	73.9710	5.46565	6.94678
1992	866.348	73.4555	74.6690	5.51686	6.73683
1993	889.985	74.0624	75.4617	4.93605	6.23594
1994	916.583	74.8826	76.4559	4.81378	6.00054

ID	RNHP :S	RPDY :S	RPY :S	RPYR :S	RSAL :S
1987	66.9158	11203.5	14414.6	3.67736	5047.62
1988	71.6617	11526.5	14867.4	3.14118	5556.95
1989	73.2077	11793.9	15222.7	2.39005	5968.11
1990	74.6844	12135.2	15619.2	2.60435	6519.75
1991	77.5253	12513.3	16053.7	2.79277	7139.40
1992	80.3340	12942.1	16560.5	3.15721	7854.35
1993	83.1186	13439.3	17161.2	3.62718	8705.15
1994	85.6944	13967.2	17812.2	3.79326	9647.89

ID	RSAL81 :S	RWOP :S	SA :S	SC :S	SI :S
1987	3775.21	4.98125	1917.91	1936.12	63.2095
1988	4040.18	4.03786	2246.83	2184.07	.454223
1989	4170.64	4.28986	2270.02	2258.82	-10.7479
1990	4340.67	4.47069	2383.19	2407.28	13.3170
1991	4568.90	4.69567	2509.96	2572.62	75.9708
1992	4845.54	4.87883	2668.64	2718.06	125.382
1993	5160.69	5.00221	2767.46	2756.81	114.731
1994	5489.77	5.10546	2971.90	2943.61	86.4498

ID	SS :S	TA :S	TC :S	TO :S	TS :S
1987	2161.29	2186.89	2181.35	11205.1	2365.75
1988	2164.45	2825.65	2536.87	11773.7	2557.57
1989	2381.69	3471.05	2756.61	12232.6	2828.45
1990	2415.52	3885.09	3063.99	12816.1	3202.14
1991	2747.25	4132.62	3323.58	13385.5	3266.19
1992	2661.34	4382.28	3462.49	14043.6	3536.33
1993	2850.36	4874.13	3818.58	14706.4	4044.94
1994	3028.22	5488.13	4353.11	15440.5	4629.53

ID	TSO :S	UR :S	URA :S	VR :S	VRR :S
1987	13437.8	11.3217	9.57496	16.6152	16.5771
1988	14049.0	9.24501	8.55100	16.1950	19.3251
1989	14393.1	9.29090	8.28521	15.0106	18.2668
1990	15028.2	9.12859	8.23779	14.7191	18.1243
1991	15709.7	8.45865	7.58107	14.7945	18.6284
1992	16457.3	7.69354	6.84848	14.6667	18.5759
1993	17312.3	6.90870	6.23639	15.0518	19.4629
1994	18294.6	6.51574	5.89195	15.6010	20.5275

ID	WAP :S	WAPA :S	WR :S	WRA :S	WRAR :S
1987	563.504	1767.80	431.219	450.499	.336237
1988	570.858	1792.96	446.138	466.973	3.65680
1989	583.895	1836.04	470.418	486.769	4.23921
1990	599.567	1886.50	494.753	510.415	4.85777
1991	615.662	1937.04	515.033	527.730	3.39232
1992	633.718	1992.37	536.634	553.192	4.82471
1993	654.579	2054.64	561.335	580.912	5.01104
1994	678.055	2122.80	591.009	610.170	5.03648

ID	WRR :S
1987	.636895
1988	3.45974
1989	5.44230
1990	5.17318
1991	4.09902
1992	4.19398
1993	4.60288
1994	5.28638

APPENDIX IV

SIMULATED RESULTS - LOW OIL PRICE SCENARIO

ID	ABSOF :S	APTVR :S	BPC :S	BPCR :S	BPR :S
1987	255.972	5.64801	268.448	200.776	181.526
1988	111.050	4.69255	391.902	284.932	248.908
1989	286.703	4.63379	448.552	312.256	285.896
1990	157.201	4.72759	445.518	297.167	283.059
1991	249.775	4.52852	491.080	315.820	341.789
1992	217.724	4.13337	546.216	340.357	428.548
1993	224.226	3.58247	621.578	374.727	532.648
1994	230.425	3.35307	699.518	408.137	645.651

ID	BPRR :S	BPT :S	BPTR :S	CPI :S	CPIR :S
1987	135.767	449.344	336.073	133.704	4.21219
1988	180.968	447.912	325.654	137.542	2.87043
1989	199.916	454.893	318.088	143.008	3.97411
1990	188.804	477.742	318.661	149.921	4.83437
1991	219.818	533.886	343.363	155.487	3.71228
1992	267.035	564.026	351.455	160.483	3.21310
1993	321.114	607.807	366.425	165.875	3.35965
1994	376.708	666.966	389.145	171.392	3.32646

ID	EMPA :S	EMPE :S	GDP :S	GDPE :S	GDPER :S
1987	1151.02	363.971	15.0405	4552.48	7.11408
1988	1186.59	375.457	15.7314	4755.58	4.46120
1989	1218.95	383.973	16.1277	4909.75	3.24186
1990	1256.61	392.848	16.6492	5047.64	2.80846
1991	1301.70	402.690	17.1665	5189.76	2.81560
1992	1350.15	414.491	17.7103	5283.64	1.80891
1993	1403.31	429.053	18.3159	5420.60	2.59222
1994	1461.25	444.461	18.9523	5592.07	3.16332

ID	GDPIP :S	GDPR :S	ISP :S	ISPR :S	LF :S
1987	381.430	2.61156	122.702	2.59405	410.440
1988	396.249	4.58818	128.292	4.55595	413.704
1989	419.072	2.51183	134.810	5.08050	424.182
1990	445.831	3.23013	139.135	3.20818	434.386
1991	464.664	3.10347	143.615	3.21978	443.209
1992	484.402	3.16709	148.754	3.57833	453.549
1993	507.099	3.41561	153.671	3.30519	466.399
1994	529.184	3.46428	159.791	3.98260	481.798

ID	LFA :S	MA :S	MC :S	MIGINA :S	MIGINE :S
1987	1272.90	268.985	245.230	70.2936	29.8471
1988	1297.54	578.822	352.796	74.9375	30.9742
1989	1331.10	1178.01	489.137	70.8434	30.8461
1990	1374.49	1402.51	611.969	69.5975	30.7705
1991	1416.31	1394.43	619.714	80.6848	32.8338
1992	1459.27	1332.67	489.889	95.8883	35.6025
1993	1507.61	1593.90	700.852	110.993	38.4545
1994	1563.88	1902.78	964.357	121.173	40.5764

ID	MIGNA :S	MIGNE :S	MIGOTA :S	MIGOTE :S	MR :S
1987	-16.9455	-1.82282	87.2392	31.4897	11.0163
1988	8.01088	2.84071	86.9287	28.3334	10.8155
1989	5.23612	2.51632	85.6073	28.1297	11.7045
1990	-2.84743	1.58503	72.4449	29.1855	11.8859
1991	-3.78165	1.79218	84.4865	31.0416	10.9811
1992	.205824	2.82909	95.6827	32.7734	10.4699
1993	5.94358	4.23488	105.049	34.2196	10.2998
1994	9.73430	5.37025	111.439	35.2061	10.1867

ID	MS :S	NC :S	NHP :S	NHPR :S	POPA :S
1987	204.461	6.39935	89.4693	4.52030	2380.25
1988	393.116	538.399	98.5650	10.1662	2408.13
1989	422.998	315.972	104.433	5.95414	2455.58
1990	700.172	555.817	111.094	6.37774	2508.18
1991	296.491	565.556	118.902	7.02871	2556.93
1992	534.977	599.731	126.289	6.19530	2607.87
1993	759.792	661.886	134.134	6.22878	2664.38
1994	1095.39	733.447	142.095	5.93514	2726.43

ID	POPE :S	PR :S	PRA :S	RIR :S	RMR :S
1987	786.794	72.8370	72.0047	5.28780	6.80411
1988	795.126	72.4705	72.3888	7.92956	7.94514
1989	809.525	72.6878	72.5406	8.02588	7.73046
1990	825.819	72.8462	73.0586	5.66562	7.05157
1991	841.228	72.4735	73.6033	5.78771	7.26884
1992	857.644	72.4478	74.1115	6.03689	7.25687
1993	876.238	72.5975	74.6842	5.64034	6.94023
1994	897.108	72.9041	75.4370	5.67353	6.86030

ID	RNHP :S	RPDY :S	RPY :S	RPYR :S	RSAL :S
1987	66.9158	11203.5	14414.6	3.67736	5047.62
1988	71.8617	11526.5	14867.4	3.14118	5556.95
1989	73.0283	11745.1	15174.2	2.06352	5891.64
1990	74.1014	12013.8	15489.5	2.07838	6328.01
1991	76.4710	12293.1	15806.0	2.04277	6788.17
1992	78.6805	12603.9	16163.2	2.26019	7306.73
1993	80.8646	12965.6	16587.6	2.62569	7922.10
1994	82.9062	13346.5	17042.0	2.73942	8595.17

ID	RSAL81 :S	RWOP :S	SA :S	SC :S	SI :S
1987	3775.21	4.98125	1917.91	1936.12	63.2095
1988	4040.18	4.03786	2246.83	2184.07	.454223
1989	4119.79	3.81795	2261.80	2258.82	-2.52136
1990	4220.87	3.58879	2344.71	2399.06	51.8287
1991	4365.74	3.44334	2419.49	2535.10	167.439
1992	4552.95	3.30303	2502.48	2614.76	279.721
1993	4775.95	3.15519	2506.02	2555.21	328.913
1994	5014.89	3.02351	2617.23	2636.91	348.598

ID	SS :S	TA :S	TC :S	TO :S	TS :S
1987	2181.29	2186.89	2181.35	11205.1	2365.75
1988	2164.45	2825.85	2536.87	11773.7	2557.57
1989	2381.69	3439.81	2747.96	12214.6	2804.69
1990	2397.81	3747.23	3011.03	12768.0	3097.99
1991	2687.19	3813.92	3154.81	13294.6	2983.68
1992	2509.38	3835.15	3104.65	13894.1	3044.35
1993	2594.89	4099.93	3256.06	14485.7	3354.68
1994	2688.30	4520.01	3601.27	15134.6	3763.70

ID	TSO :S	UR :S	URA :S	VR :S	VRR :S
1987	13437.8	11.3217	9.57496	16.6152	16.5771
1988	14049.0	9.24501	8.55100	18.1950	19.3251
1989	14393.1	9.47910	8.42586	15.1362	18.5555
1990	15028.2	9.56264	8.57662	15.0391	18.8197
1991	15673.6	9.14209	8.09266	15.1782	19.5125
1992	16358.8	8.61154	7.47787	15.0664	19.5960
1993	17118.0	8.00735	6.91829	15.3772	20.4835
1994	17962.3	7.74940	6.56227	15.7425	21.3651

ID	WAP :S	WAPA :S	WR :S	WRA :S	WRAR :S
1987	563.504	1767.80	431.219	450.499	.336237
1988	570.858	1792.96	446.138	466.973	3.65680
1989	583.567	1834.98	470.070	486.397	4.15954
1990	597.947	1881.36	492.988	508.354	4.51418
1991	611.545	1924.25	510.463	522.349	2.75303
1992	626.036	1969.02	527.911	543.234	3.99831
1993	642.445	2018.64	547.143	565.251	4.05282
1994	660.865	2073.10	570.194	587.785	3.98666

ID	WRR :S
1987	.636895
1988	3.45974
1989	5.36439
1990	4.87534
1991	3.54468
1992	3.41810
1993	3.64311
1994	4.21296

APPENDIX V

COMPARISON OF TWO OIL PRICE SCENARIOS

ABSOF	High	Low	Residual	%Residual	APTVR	High	Low	Residual	%Residual
1987	255.97	255.97	0.00	0.00	1987	5.65	5.65	0.00	0.00
1988	111.05	111.05	0.00	0.00	1988	4.69	4.69	0.00	0.00
1989	324.53	286.70	37.82	.12	1989	4.51	4.63	-.12	-.03
1990	218.18	157.20	60.98	.28	1990	4.42	4.73	-.31	-.07
1991	334.50	249.78	84.73	.25	1991	4.02	4.53	-.51	-.13
1992	331.03	217.72	113.30	.34	1992	3.45	4.13	-.68	-.20
1993	358.35	224.23	134.12	.37	1993	2.79	3.58	-.79	-.28
1994	386.16	230.43	155.74	.40	1994	2.48	3.35	-.87	-.35

BPC	High	Low	Residual	%Residual	BPCR	High	Low	Residual	%Residual
1987	268.45	268.45	0.00	0.00	1987	200.78	200.78	0.00	0.00
1988	391.90	391.90	0.00	0.00	1988	284.93	284.93	0.00	0.00
1989	455.72	446.55	9.17	.02	1989	318.47	312.26	6.21	.02
1990	482.47	445.52	36.96	.08	1990	321.22	297.17	24.05	.07
1991	555.06	491.06	64.00	.12	1991	355.21	315.82	39.39	.11
1992	640.66	546.22	94.44	.15	1992	395.24	340.36	54.88	.14
1993	748.29	621.58	126.71	.17	1993	443.61	374.73	68.88	.16
1994	860.22	699.52	160.70	.19	1994	489.47	408.14	81.34	.17

BPR	High	Low	Residual	%Residual	BPRR	High	Low	Residual	%Residual
1987	181.53	181.53	0.00	0.00	1987	135.77	135.77	0.00	0.00
1988	248.91	248.91	0.00	0.00	1988	180.97	180.97	0.00	0.00
1989	297.35	285.90	11.45	.04	1989	207.79	199.92	7.88	.04
1990	325.21	283.06	42.15	.13	1990	216.52	188.80	27.71	.13
1991	421.56	341.79	79.77	.19	1991	269.78	219.82	49.96	.19
1992	550.66	428.55	122.11	.22	1992	339.71	267.04	72.68	.21
1993	698.51	532.65	165.86	.24	1993	414.10	321.11	92.98	.22
1994	854.86	645.65	209.21	.24	1994	486.43	376.71	109.72	.23

BPT	High	Low	Residual	%Residual	BPTR	High	Low	Residual	%Residual
1987	449.34	449.34	0.00	0.00	1987	336.07	336.07	0.00	0.00
1988	447.91	447.91	0.00	0.00	1988	325.65	325.65	0.00	0.00
1989	477.46	454.89	22.56	.05	1989	333.66	318.09	15.57	.05
1990	534.06	477.74	56.32	.11	1990	355.57	318.66	36.90	.10
1991	635.43	533.89	101.55	.16	1991	406.65	343.36	63.29	.16
1992	723.50	564.03	159.47	.22	1992	446.34	351.46	94.89	.21
1993	830.34	607.81	222.54	.27	1993	492.26	366.43	125.83	.26
1994	957.29	666.97	290.33	.30	1994	544.71	389.15	155.57	.29

CPI	High	Low	Residual	%Residual	CPIR	High	Low	Residual	%Residual
1987	133.70	133.70	0.00	0.00	1987	4.21	4.21	0.00	0.00
1988	137.54	137.54	0.00	0.00	1988	2.87	2.87	0.00	0.00
1989	143.10	143.01	.09	.00	1989	4.04	3.97	.07	.02
1990	150.20	149.92	.28	.00	1990	4.96	4.83	.13	.03
1991	156.26	155.49	.77	.00	1991	4.03	3.71	.32	.08
1992	162.09	160.48	1.61	.01	1992	3.73	3.21	.52	.14
1993	168.68	165.88	2.81	.02	1993	4.06	3.36	.70	.17
1994	175.74	171.39	4.35	.02	1994	4.19	3.33	.86	.21

EMPA	High	Low	Residual	%Residual
1987	1151.02	1151.02	0.00	0.00
1988	1186.59	1186.59	0.00	0.00
1989	1223.03	1218.95	4.08	.00
1990	1268.36	1256.61	11.75	.01
1991	1324.22	1301.70	22.53	.02
1992	1385.80	1350.15	35.65	.03
1993	1453.77	1403.31	50.47	.03
1994	1527.38	1461.25	66.12	.04

EMPE	High	Low	Residual	%Residual
1987	363.97	363.97	0.00	0.00
1988	375.46	375.46	0.00	0.00
1989	385.67	383.97	1.69	.00
1990	397.58	392.85	4.73	.01
1991	411.98	402.69	9.29	.02
1992	429.79	414.49	15.20	.04
1993	451.30	429.05	22.25	.05
1994	474.66	444.46	30.20	.06

GDP	High	Low	Residual	%Residual
1987	15.04	15.04	0.00	0.00
1988	15.73	15.73	0.00	0.00
1989	16.22	16.13	.09	.01
1990	16.86	16.65	.21	.01
1991	17.52	17.17	.35	.02
1992	18.22	17.71	.51	.03
1993	19.00	18.32	.68	.04
1994	19.81	18.95	.85	.04

GDPE	High	Low	Residual	%Residual
1987	4552.48	4552.48	0.00	0.00
1988	4755.58	4755.58	0.00	0.00
1989	4942.84	4909.75	33.09	.01
1990	5122.20	5047.64	74.56	.01
1991	5319.46	5189.76	129.70	.02
1992	5481.30	5283.64	197.67	.04
1993	5698.82	5420.60	278.22	.05
1994	5961.55	5592.07	369.48	.06

GDPER	High	Low	Residual	%Residual
1987	7.11	7.11	0.00	0.00
1988	4.46	4.46	0.00	0.00
1989	3.94	3.24	.70	.18
1990	3.63	2.81	.82	.23
1991	3.85	2.82	1.04	.27
1992	3.04	1.81	1.23	.41
1993	3.97	2.59	1.38	.35
1994	4.61	3.16	1.45	.31

GDPIP	High	Low	Residual	%Residual
1987	381.43	381.43	0.00	0.00
1988	396.25	396.25	0.00	0.00
1989	419.59	419.07	.52	.00
1990	447.36	445.83	1.53	.00
1991	468.52	464.66	3.85	.01
1992	491.92	484.40	7.52	.02
1993	519.77	507.10	12.67	.02
1994	548.43	529.18	19.25	.04

GDPR	High	Low	Residual	%Residual
1987	2.61	2.61	0.00	0.00
1988	4.59	4.59	0.00	0.00
1989	3.10	2.51	.58	.19
1990	3.93	3.23	.70	.18
1991	3.92	3.10	.82	.21
1992	4.01	3.17	.84	.21
1993	4.24	3.42	.82	.19
1994	4.24	3.46	.77	.18

ISP	High	Low	Residual	%Residual
1987	122.70	122.70	0.00	0.00
1988	128.29	128.29	0.00	0.00
1989	134.87	134.81	.06	.00
1990	139.55	139.14	.41	.00
1991	144.68	143.62	1.07	.01
1992	150.83	148.75	2.08	.01
1993	157.12	153.67	3.44	.02
1994	164.92	159.79	5.13	.03

ISPR	High	Low	Residual	%Residual
1987	2.59	2.59	0.00	0.00
1988	4.56	4.56	0.00	0.00
1989	5.13	5.08	.05	.01
1990	3.46	3.21	.26	.07
1991	3.68	3.22	.46	.13
1992	4.25	3.58	.67	.16
1993	4.17	3.31	.86	.21
1994	4.97	3.98	.99	.20

LF	High	Low	Residual	%Residual
1987	410.44	410.44	0.00	0.00
1988	413.70	413.70	0.00	0.00
1989	425.17	424.18	.99	.00
1990	437.52	434.39	3.13	.01
1991	450.04	443.21	6.83	.02
1992	465.50	453.55	11.95	.03
1993	484.80	466.40	18.40	.04
1994	507.75	481.80	25.95	.05

LFA	High	Low	Residual	%Residual
1987	1272.90	1272.90	0.00	0.00
1988	1297.54	1297.54	0.00	0.00
1989	1333.51	1331.10	2.41	.00
1990	1382.22	1374.49	7.73	.01
1991	1432.85	1416.31	16.53	.01
1992	1487.68	1459.27	28.41	.02
1993	1550.47	1507.61	42.86	.03
1994	1623.00	1563.88	59.12	.04

MA	High	Low	Residual	%Residual
1987	268.99	268.99	0.00	0.00
1988	578.82	578.82	0.00	0.00
1989	1201.03	1178.01	23.01	.02
1990	1501.90	1402.51	99.38	.07
1991	1622.85	1394.43	228.22	.14
1992	1713.83	1332.67	380.95	.22
1993	2106.86	1593.90	512.76	.24
1994	2516.23	1902.78	613.45	.24

MC	High	Low	Residual	%Residual
1987	245.23	245.23	0.00	0.00
1988	352.80	352.80	0.00	0.00
1989	497.79	489.14	8.66	.02
1990	656.74	611.97	44.77	.07
1991	750.96	619.71	131.25	.17
1992	744.44	489.89	254.55	.34
1993	1061.76	700.85	360.91	.34
1994	1409.49	964.36	445.14	.32

MIGINA	High	Low	Residual	%Residual
1987	70.29	70.29	0.00	0.00
1988	74.94	74.94	0.00	0.00
1989	76.12	70.84	5.27	.07
1990	80.30	69.60	10.71	.13
1991	96.55	80.68	15.86	.16
1992	115.59	95.89	19.70	.17
1993	133.04	110.99	22.05	.17
1994	144.03	121.17	22.86	.16

MIGINE	High	Low	Residual	%Residual
1987	29.85	29.85	0.00	0.00
1988	30.97	30.97	0.00	0.00
1989	31.52	30.65	.87	.03
1990	32.59	30.77	1.82	.06
1991	35.61	32.83	2.78	.08
1992	39.19	35.60	3.58	.09
1993	42.65	38.45	4.20	.10
1994	45.18	40.58	4.61	.10

MIGNA	High	Low	Residual	%Residual
1987	-16.95	-16.95	0.00	0.00
1988	8.01	8.01	0.00	0.00
1989	7.65	5.24	2.42	.32
1990	3.91	-2.85	6.76	1.73
1991	6.58	-3.78	10.36	1.57
1992	13.39	.21	13.18	.98
1993	20.70	5.94	14.76	.71
1994	24.86	9.73	15.13	.61

MIGNE	High	Low	Residual	%Residual
1987	-1.62	-1.62	0.00	0.00
1988	2.64	2.64	0.00	0.00
1989	2.95	2.52	.43	.15
1990	2.80	1.59	1.21	.43
1991	3.72	1.79	1.93	.52
1992	5.41	2.83	2.58	.48
1993	7.31	4.23	3.07	.42
1994	8.78	5.37	3.41	.39

MIGOTA	High	Low	Residual	%Residual
1987	87.24	87.24	0.00	0.00
1988	66.93	66.93	0.00	0.00
1989	68.47	65.61	2.86	.04
1990	76.39	72.44	3.95	.05
1991	89.96	84.47	5.50	.06
1992	102.20	95.68	6.52	.06
1993	112.34	105.05	7.29	.06
1994	119.17	111.44	7.73	.06

MIGOTE	High	Low	Residual	%Residual
1987	31.47	31.47	0.00	0.00
1988	28.33	28.33	0.00	0.00
1989	28.57	28.13	.44	.02
1990	29.80	29.19	.61	.02
1991	31.89	31.04	.85	.03
1992	33.78	32.77	1.01	.03
1993	35.35	34.22	1.13	.03
1994	36.40	35.21	1.19	.03

MR	High	Low	Residual	%Residual
1987	11.02	11.02	0.00	0.00
1988	10.82	10.82	0.00	0.00
1989	11.70	11.70	0.00	0.00
1990	11.89	11.89	0.00	0.00
1991	10.98	10.98	0.00	0.00
1992	10.47	10.47	0.00	0.00
1993	10.30	10.30	0.00	0.00
1994	10.19	10.19	0.00	0.00

MS	High	Low	Residual	%Residual
1987	204.46	204.46	0.00	0.00
1988	393.12	393.12	0.00	0.00
1989	446.76	423.00	23.76	.05
1990	786.62	700.17	86.45	.11
1991	518.94	296.49	222.44	.43
1992	874.99	534.98	340.01	.39
1993	1194.58	759.79	434.79	.36
1994	1801.31	1095.39	505.92	.32

NC	High	Low	Residual	%Residual
1987	6.40	6.40	0.00	0.00
1988	538.40	538.40	0.00	0.00
1989	315.97	315.97	0.00	0.00
1990	555.62	555.62	0.00	0.00
1991	595.05	565.56	29.50	.05
1992	650.86	599.73	51.12	.08
1993	740.44	661.89	78.55	.11
1994	846.77	733.45	113.32	.13

NHP	High	Low	Residual	%Residual
1987	89.47	89.47	0.00	0.00
1988	98.57	98.57	0.00	0.00
1989	104.76	104.43	.33	.00
1990	112.18	111.09	1.08	.01
1991	121.14	118.90	2.24	.02
1992	130.22	126.27	3.95	.03
1993	140.21	134.13	6.07	.04
1994	150.60	142.10	8.51	.06

NHPR	High	Low	Residual	%Residual
1987	4.52	4.52	0.00	0.00
1988	10.17	10.17	0.00	0.00
1989	6.28	5.95	.33	.05
1990	7.08	6.38	.70	.10
1991	7.99	7.03	.96	.12
1992	7.49	6.20	1.30	.17
1993	7.67	6.23	1.44	.19
1994	7.41	5.94	1.48	.20

POPA	High	Low	Residual	%Residual
1987	2380.25	2380.25	0.00	0.00
1988	2408.13	2408.13	0.00	0.00
1989	2456.79	2455.58	1.21	.00
1990	2514.04	2508.18	5.86	.00
1991	2571.50	2556.93	14.57	.01
1992	2634.48	2607.87	26.61	.01
1993	2705.42	2664.38	41.03	.02
1994	2783.08	2726.43	56.65	.02

POPE	High	Low	Residual	%Residual
1987	786.79	786.79	0.00	0.00
1988	795.13	795.13	0.00	0.00
1989	809.90	809.53	.37	.00
1990	827.65	825.82	1.84	.00
1991	845.89	841.23	4.66	.01
1992	866.35	857.64	8.70	.01
1993	889.99	876.24	13.75	.02
1994	916.58	897.11	19.48	.02

PR	High	Low	Residual	%Residual
1987	72.84	72.84	0.00	0.00
1988	72.47	72.47	0.00	0.00
1989	72.82	72.69	.13	.00
1990	72.97	72.65	.33	.00
1991	73.10	72.47	.63	.01
1992	73.46	72.45	1.01	.01
1993	74.06	72.60	1.46	.02
1994	74.88	72.90	1.98	.03

PRA	High	Low	Residual	%Residual
1987	72.00	72.00	0.00	0.00
1988	72.37	72.37	0.00	0.00
1989	72.63	72.54	.09	.00
1990	73.27	73.06	.21	.00
1991	73.97	73.60	.37	.00
1992	74.67	74.11	.56	.01
1993	75.46	74.68	.78	.01
1994	76.46	75.44	1.02	.01

RIR	High	Low	Residual	%Residual
1987	5.29	5.29	0.00	0.00
1988	7.93	7.93	0.00	0.00
1989	7.96	8.03	-.07	-.01
1990	5.54	5.67	-.13	-.02
1991	5.47	5.79	-.32	-.06
1992	5.52	6.04	-.52	-.09
1993	4.94	5.64	-.70	-.14
1994	4.81	5.67	-.86	-.18

RMR	High	Low	Residual	%Residual
1987	6.80	6.80	0.00	0.00
1988	7.95	7.95	0.00	0.00
1989	7.67	7.73	-.07	-.01
1990	6.92	7.05	-.13	-.02
1991	6.95	7.27	-.32	-.05
1992	6.74	7.26	-.52	-.08
1993	6.24	6.94	-.70	-.11
1994	6.00	6.86	-.86	-.14

RNHP	High	Low	Residual	%Residual
1987	66.92	66.92	0.00	0.00
1988	71.66	71.66	0.00	0.00
1989	73.21	73.03	.18	.00
1990	74.68	74.10	.58	.01
1991	77.53	76.47	1.05	.01
1992	80.33	78.68	1.65	.02
1993	83.12	80.86	2.25	.03
1994	85.69	82.91	2.79	.03

RPDY	High	Low	Residual	%Residual
1987	11203.50	11203.50	0.00	0.00
1988	11526.50	11526.50	0.00	0.00
1989	11793.90	11745.10	48.84	.00
1990	12135.20	12013.80	121.43	.01
1991	12513.30	12293.10	220.22	.02
1992	12942.10	12603.90	338.24	.03
1993	13439.30	12965.80	473.53	.04
1994	13967.20	13346.50	620.79	.04

RPY	High	Low	Residual	%Residual
1987	14414.60	14414.60	0.00	0.00
1988	14867.40	14867.40	0.00	0.00
1989	15222.70	15174.20	48.55	.00
1990	15619.20	15489.50	129.62	.01
1991	16053.70	15806.00	247.70	.02
1992	16560.50	16183.20	397.30	.02
1993	17161.20	16587.60	573.58	.03
1994	17812.20	17042.00	770.15	.04

RPYR	High	Low	Residual	%Residual
1987	3.68	3.68	0.00	0.00
1988	3.14	3.14	0.00	0.00
1989	2.39	2.06	.33	.14
1990	2.60	2.08	.53	.20
1991	2.78	2.04	.74	.27
1992	3.16	2.26	.90	.28
1993	3.83	2.83	1.00	.28
1994	3.79	2.74	1.05	.28

RSAL	High	Low	Residual	%Residual
1987	5047.62	5047.62	0.00	0.00
1988	5556.95	5556.95	0.00	0.00
1989	5968.11	5891.84	76.47	.01
1990	6519.75	6328.01	191.74	.03
1991	7139.40	6788.17	351.23	.05
1992	7854.35	7306.73	547.62	.07
1993	8705.15	7922.10	783.05	.09
1994	9647.89	8595.17	1052.72	.11

RSAL81	High	Low	Residual	%Residual
1987	3775.21	3775.21	0.00	0.00
1988	4040.18	4040.18	0.00	0.00
1989	4170.84	4119.79	50.85	.01
1990	4340.67	4220.87	119.80	.03
1991	4568.90	4365.74	203.16	.04
1992	4845.54	4552.95	292.59	.06
1993	5160.69	4775.95	384.75	.07
1994	5489.77	5014.89	474.87	.09

RWOP	High	Low	Residual	%Residual
1987	4.98	4.98	0.00	0.00
1988	4.04	4.04	0.00	0.00
1989	4.29	3.82	.47	.11
1990	4.47	3.59	.88	.20
1991	4.70	3.44	1.25	.27
1992	4.88	3.30	1.58	.32
1993	5.00	3.16	1.85	.37
1994	5.11	3.02	2.08	.41

SA	High	Low	Residual	%Residual
1987	1917.91	1917.91	0.00	0.00
1988	2246.83	2246.83	0.00	0.00
1989	2270.02	2261.80	8.23	.00
1990	2383.19	2344.71	38.48	.02
1991	2509.86	2419.49	90.48	.04
1992	2668.54	2502.48	166.17	.06
1993	2767.46	2506.02	261.44	.09
1994	2971.90	2617.23	354.67	.12

SC	High	Low	Residual	%Residual
1987	1936.12	1936.12	0.00	0.00
1988	2184.07	2184.07	0.00	0.00
1989	2258.82	2258.82	0.00	0.00
1990	2407.26	2399.06	8.20	.00
1991	2572.62	2535.10	37.52	.01
1992	2718.06	2614.76	103.30	.04
1993	2756.81	2555.21	201.60	.07
1994	2943.61	2636.91	306.70	.10

SI	High	Low	Residual	%Residual
1987	63.21	63.21	0.00	0.00
1988	.45	.45	0.00	0.00
1989	-10.75	-2.52	-8.23	.77
1990	13.32	51.83	-38.51	-2.89
1991	75.97	167.44	-91.47	-1.20
1992	125.38	279.72	-154.34	-1.23
1993	114.73	328.91	-214.18	-1.87
1994	86.45	348.60	-262.15	-3.03

SS	High	Low	Residual	%Residual
1987	2161.29	2161.29	0.00	0.00
1988	2164.45	2164.45	0.00	0.00
1989	2381.69	2381.69	0.00	0.00
1990	2415.62	2397.81	17.71	.01
1991	2747.25	2687.19	60.06	.02
1992	2861.34	2509.38	151.97	.06
1993	2850.36	2594.89	255.47	.09
1994	3028.22	2668.30	359.91	.12

TA	High	Low	Residual	%Residual
1987	2186.89	2186.89	0.00	0.00
1988	2825.65	2825.65	0.00	0.00
1989	3471.05	3439.81	31.24	.01
1990	3885.09	3747.23	137.87	.04
1991	4132.62	3813.92	318.69	.08
1992	4382.28	3835.15	547.12	.12
1993	4874.13	4099.93	774.20	.16
1994	5488.13	4520.01	968.12	.18

TC	High	Low	Residual	%Residual
1987	2181.35	2181.35	0.00	0.00
1988	2536.87	2536.87	0.00	0.00
1989	2756.61	2747.96	8.66	.00
1990	3063.99	3011.03	52.97	.02
1991	3323.58	3154.81	168.77	.05
1992	3462.49	3104.65	357.84	.10
1993	3818.58	3256.06	562.51	.15
1994	4353.11	3601.27	751.84	.17

TO	High	Low	Residual	%Residual
1987	11205.10	11205.10	0.00	0.00
1988	11773.70	11773.70	0.00	0.00
1989	12232.60	12214.60	18.07	.00
1990	12816.10	12768.00	48.08	.00
1991	13385.50	13294.60	90.90	.01
1992	14043.60	13894.10	149.44	.01
1993	14706.40	14485.70	220.77	.02
1994	15440.50	15134.60	305.89	.02

TS	High	Low	Residual	%Residual
1987	2365.75	2365.75	0.00	0.00
1988	2557.57	2557.57	0.00	0.00
1989	2828.45	2804.69	23.76	.01
1990	3202.14	3097.99	104.15	.03
1991	3266.19	2983.68	282.51	.09
1992	3536.33	3044.35	491.98	.14
1993	4044.94	3354.68	690.26	.17
1994	4629.53	3763.70	865.84	.19

TSO	High	Low	Residual	%Residual
1987	13437.80	13437.80	0.00	0.00
1988	14049.00	14049.00	0.00	0.00
1989	14393.10	14393.10	0.00	0.00
1990	15028.20	15028.20	0.00	0.00
1991	15709.70	15673.60	36.08	.00
1992	16457.30	16358.80	98.51	.01
1993	17312.30	17118.00	194.31	.01
1994	18294.60	17962.30	332.34	.02

UR	High	Low	Residual	%Residual
1987	11.32	11.32	0.00	0.00
1988	9.25	9.25	0.00	0.00
1989	9.29	9.48	-.19	-.02
1990	9.13	9.56	-.43	-.05
1991	8.48	9.14	-.66	-.08
1992	7.69	8.61	-.92	-.12
1993	6.91	8.01	-1.10	-.16
1994	6.52	7.75	-1.23	-.19

URA	High	Low	Residual	%Residual
1987	9.57	9.57	0.00	0.00
1988	8.55	8.55	0.00	0.00
1989	8.29	8.43	-.14	-.02
1990	8.24	8.58	-.34	-.04
1991	7.58	8.09	-.51	-.07
1992	6.85	7.48	-.63	-.09
1993	6.24	6.92	-.68	-.11
1994	5.89	6.56	-.67	-.11

VR	High	Low	Residual	%Residual
1987	16.62	16.62	0.00	0.00
1988	16.20	16.20	0.00	0.00
1989	15.01	15.14	-.13	-.01
1990	14.72	15.04	-.32	-.02
1991	14.79	15.18	-.38	-.03
1992	14.67	15.07	-.40	-.03
1993	15.05	15.38	-.33	-.02
1994	15.60	15.74	-.14	-.01

VRR	High	Low	Residual	%Residual
1987	16.58	16.58	0.00	0.00
1988	16.33	16.33	0.00	0.00
1989	16.27	16.56	-.29	-.02
1990	16.12	16.82	-.70	-.04
1991	16.63	19.51	-.88	-.05
1992	16.58	19.60	-1.02	-.05
1993	19.46	20.48	-1.02	-.05
1994	20.53	21.37	-.84	-.04

WAP	High	Low	Residual	%Residual
1987	563.50	563.50	0.00	0.00
1988	570.86	570.86	0.00	0.00
1989	583.90	583.57	.33	.00
1990	599.57	597.95	1.62	.00
1991	615.86	611.55	4.12	.01
1992	633.72	626.04	7.68	.01
1993	654.58	642.45	12.13	.02
1994	678.06	660.87	17.19	.03

WAPA	High	Low	Residual	%Residual
1987	1767.80	1767.80	0.00	0.00
1988	1792.96	1792.96	0.00	0.00
1989	1836.04	1834.98	1.06	.00
1990	1886.50	1881.36	5.14	.00
1991	1937.04	1924.25	12.79	.01
1992	1992.37	1969.02	23.34	.01
1993	2054.84	2018.64	36.00	.02
1994	2122.80	2073.10	49.70	.02

WR	High	Low	Residual	%Residual
1987	431.22	431.22	0.00	0.00
1988	446.14	446.14	0.00	0.00
1989	470.42	470.07	.35	.00
1990	494.75	492.99	1.77	.00
1991	515.03	510.46	4.57	.01
1992	536.63	527.91	8.72	.02
1993	561.34	547.14	14.19	.03
1994	591.01	570.19	20.81	.04

WRA	High	Low	Residual	%Residual
1987	450.50	450.50	0.00	0.00
1988	466.97	466.97	0.00	0.00
1989	486.77	486.40	.37	.00
1990	510.42	508.35	2.06	.00
1991	527.73	522.35	5.38	.01
1992	553.19	543.23	9.96	.02
1993	580.91	565.25	15.66	.03
1994	610.17	587.79	22.38	.04

WRAR	High	Low	Residual	%Residual
1987	.34	.34	0.00	0.00
1988	3.66	3.66	0.00	0.00
1989	4.24	4.16	.08	.02
1990	4.86	4.51	.34	.07
1991	3.39	2.75	.64	.19
1992	4.82	4.00	.83	.17
1993	5.01	4.05	.96	.19
1994	5.04	3.99	1.05	.21

WRR	High	Low	Residual	%Residual
1987	.64	.64	0.00	0.00
1988	3.46	3.46	0.00	0.00
1989	5.44	5.36	.08	.01
1990	5.17	4.88	.30	.06
1991	4.10	3.54	.55	.14
1992	4.19	3.42	.78	.18
1993	4.60	3.64	.96	.21
1994	5.29	4.21	1.07	.20

APPENDIX VI

HISTORICAL DATA USED FOR ESTIMATING THE MODEL

+ ID	ABSOF	APTVR	BPC	BPCR	BPR
1971A	853.500	NA	96.7420	225.506	103.402
1972A	30.0000	7.60000	100.656	229.808	90.3600
1973A	208.500	5.30000	123.017	258.439	77.6560
1974A	631.700	.800000	194.400	373.129	72.2440
1975A	477.100	.300000	152.510	264.315	188.610
1976A	602.150	1.000000E-02	193.666	310.860	290.990
1977A	788.200	.100000	252.781	371.737	376.789
1978A	588.150	.800000	286.067	386.055	460.159
1979A	643.900	1.90000	397.468	492.525	391.703
1980A	806.980	1.10000	528.206	594.157	344.994
1981A	1040.26	1.10000	633.136	633.136	523.902
1982A	-317.774	4.00000	474.202	427.980	328.425
1983A	85.1240	8.50000	378.316	322.795	204.927
1984A	160.252	10.4000	222.159	184.517	111.771
1985A	514.128	5.90000	336.020	270.548	145.400
1986A	306.340	4.30000	403.260	314.310	131.218
1987A	252.868	5.60000	268.427	200.768	181.201

+ ID	BPRR	BPT	BPTR	CPI	CPIR
1971A	241.030	200.144	447.671	42.9000	4.00000
1972A	206.301	191.016	436.110	43.8000	4.50000
1973A	163.143	200.673	421.582	47.6000	8.70000
1974A	138.664	266.884	511.870	52.1000	9.50000
1975A	326.880	341.120	591.196	57.7000	10.7000
1976A	467.079	484.656	777.939	62.3000	8.00000
1977A	554.101	629.570	925.838	68.0000	9.10000
1978A	620.997	746.226	1007.05	74.1000	9.00000
1979A	485.382	798.171	989.060	80.7000	8.90000
1980A	388.070	873.200	982.227	88.9000	10.2000
1981A	523.902	1157.04	1157.04	100.000	12.5000
1982A	296.412	802.627	724.393	110.800	10.8000
1983A	174.852	583.243	407.648	117.200	5.80000
1984A	92.8331	333.830	277.350	120.400	2.70000
1985A	117.069	481.420	387.617	124.200	3.20000
1986A	102.274	534.478	416.585	128.300	3.30000
1987A	135.528	449.628	336.296	133.700	4.20000

+ ID	EMPA	EMPE	FWAP	GOPCR	GDOE
1971A	643.000	199.000	49.5000	5.76000	2287.94
1972A	688.000	193.000	49.5000	5.73109	2252.15
1973A	718.000	208.000	49.6000	7.71183	2564.39
1974A	754.000	233.000	49.6000	4.40181	2889.03
1975A	788.000	268.000	49.7000	2.60175	3305.51
1976A	837.000	278.000	49.7000	6.16236	3249.40
1977A	868.000	270.000	49.7000	3.61432	3192.29
1978A	915.000	290.000	49.8000	4.57362	3530.64
1979A	1007.00	310.000	49.3000	3.87138	3860.13
1980A	1078.00	332.000	49.2000	1.48422	4000.39
1981A	1152.00	356.000	49.1000	3.67227	4183.78
1982A	1132.00	347.000	49.1000	-3.21662	3900.76
1983A	1115.00	332.000	49.1000	3.16420	3828.26
1984A	1114.00	328.000	49.3000	6.27664	3829.07
1985A	1123.00	349.000	49.8000	4.25196	4288.17
1986A	1146.00	357.000	49.3000	3.32998	4250.13
1987A	1151.00	364.000	49.4000	3.90000	4550.40

+ ID	GDP	GDP81	GPER	GPIPI	GIP81
1971A	7.86600	27.1090	NA	100.000	29.3000
1972A	8.45900	29.1800	-1.56000	105.300	31.1000
1973A	9.31700	32.1210	13.8600	119.400	35.4000
1974A	9.75400	34.3480	12.6600	160.300	46.6000
1975A	10.1930	35.2610	14.4200	183.000	53.7000
1976A	10.5810	36.6920	-1.70000	203.900	59.4000
1977A	11.1510	38.5250	-1.76000	219.100	64.0000
1978A	11.9470	40.8150	10.6000	237.000	70.3000
1979A	13.2150	45.3570	9.33000	265.200	78.7000
1980A	13.8560	47.3980	3.63000	303.100	91.0000
1981A	14.5480	50.2410	4.58000	337.600	100.000
1982A	13.8630	48.1040	-6.76000	381.400	110.900
1983A	13.4700	47.2740	-1.86000	406.400	115.500
1984A	13.7750	50.0520	2.000000E-02	419.300	116.000
1985A	14.4400	53.1830	11.9900	429.400	117.400
1986A	14.6570	54.0050	-0.890000	382.200	104.500
1987A	15.0230	55.3550	1.07000	380.300	106.300

+ ID	GDPR	GDPR81	IR	ISP	LF
1971A	6.70000	6.70000	6.48000	36.7000	210.000
1972A	7.50000	7.63953	6.00000	38.4000	204.000
1973A	10.1000	10.0788	7.65000	42.6000	218.000
1974A	4.76000	6.93316	10.7500	50.7000	241.000
1975A	4.50000	2.65809	9.42000	56.4000	279.000
1976A	3.80000	4.05831	10.0400	59.3000	290.000
1977A	5.40000	4.99564	8.50000	64.0000	282.000
1978A	7.20000	5.94419	9.69000	69.9000	305.000
1979A	10.6000	11.1283	12.9000	80.0000	322.000
1980A	4.90000	4.49985	19.2500	90.7000	347.000
1981A	5.00000	5.99815	19.2900	100.000	371.000
1982A	-4.70000	-4.25350	15.8100	106.700	377.000
1983A	-2.80000	-1.72543	11.2000	110.400	377.000
1984A	2.30000	5.87639	12.1000	115.400	381.000
1985A	4.80000	6.25550	10.7000	118.600	397.000
1986A	1.50000	1.54561	10.5000	119.600	403.000
1987A	2.50000	2.50000	9.50000	122.700	410.000

+ ID	LFA	MA	MC	MIGNA	MIGNA
1971A	682.000	NA	NA	NA	13.5490
1972A	708.000	6325.00	5987.00	NA	6.95200
1973A	741.000	5712.00	5483.00	NA	9.97000
1974A	781.000	2931.00	2608.00	NA	9.43400
1975A	822.000	1467.00	1470.00	91.8610	38.6000
1976A	871.000	2365.00	2364.00	130.415	51.7450
1977A	909.000	6419.00	7221.00	137.395	48.8450
1978A	960.000	8298.00	9090.00	139.330	48.4450
1979A	1048.00	6769.00	7651.00	149.015	57.1300
1980A	1120.00	5147.00	4590.00	154.795	66.5400
1981A	1196.00	5455.00	5282.00	164.300	54.1000
1982A	1227.00	6947.00	7294.00	80.9000	10.6000
1983A	1249.00	6146.00	5271.00	47.2000	-26.8000
1984A	1254.00	1584.00	1198.00	59.5000	-30.1000
1985A	1249.00	407.000	295.000	73.0000	-10.7000
1986A	1271.00	183.000	154.000	72.5100	-16.8800
1987A	1274.00	269.000	244.000	69.6000	-16.7900

+ ID	MIGNE	MIGOTA	MR	MS	NC
1971A	- .759000	NA	9.43000	NA	794.000
1972A	-4.43400	NA	9.21000	5113.00	.000000
1973A	-1.84800	NA	9.59000	2409.00	205.000
1974A	1.22100	NA	11.2400	1412.00	718.000
1975A	5.05400	53.2880	11.4300	2951.00	424.590
1976A	4.69800	78.6700	11.7800	6536.00	656.000
1977A	1.42700	88.5500	10.3600	7444.00	1369.00
1978A	8.05600	90.8850	10.5900	9234.00	33.0000
1979A	8.87400	91.8850	11.9800	5544.00	433.500
1980A	9.28200	88.2550	14.3200	5255.00	1289.72
1981A	13.6250	110.200	18.1500	6471.00	485.000
1982A	1.11500	70.3000	17.8900	7300.00	932.053
1983A	-3.61000	74.0000	13.2900	2053.00	1830.52
1984A	-4.00000	89.6000	13.6100	127.000	-269.239
1985A	-1.70000	83.7000	12.1800	80.0000	400.551
1986A	-2.10000	89.3900	11.2200	97.0000	229.000
1987A	-1.60000	86.3900	11.1700	205.000	3.13800

+ ID	NEP	NHP	PDY	POPA	POPE
1971A	.000000	29.0000	2749.00	1628.00	496.014
1972A	.000000	31.7000	3115.00	1657.00	505.800
1973A	.000000	38.5000	3653.00	1690.00	515.600
1974A	.000000	50.2000	4309.00	1722.00	527.800
1975A	.000000	59.7000	5080.00	1778.00	540.500
1976A	.000000	71.5000	5595.00	1838.00	554.228
1977A	.000000	76.4000	6162.00	1912.00	568.700
1978A	.000000	81.6000	7157.00	1981.00	582.000
1979A	.000000	87.9000	8152.00	2055.00	598.995
1980A	.000000	94.9000	9648.00	2142.00	616.948
1981A	.000000	100.000	11139.0	2237.00	657.057
1982A	1.00000	98.1000	11948.0	2315.00	668.459
1983A	1.00000	90.5000	12038.0	2339.00	679.465
1984A	1.00000	85.0000	12595.0	2339.00	683.000
1985A	.000000	79.8000	13716.0	2349.00	780.819
1986A	.000000	85.6000	14069.0	2375.00	785.465
1987A	.000000	89.2000	14183.0	2380.00	787.329

+ ID	PR	PRA	PY	RIR	RMR
1971A	62.2000	63.1000	3380.00	2.48000	5.43000
1972A	62.1000	63.7000	3797.00	1.50000	4.71000
1973A	63.1000	64.7000	4441.00	-1.05000	890000
1974A	63.5000	65.6000	5310.00	1.25000	1.74000
1975A	68.2000	66.1000	6233.00	-1.28000	.730000
1976A	69.2000	66.9000	6959.00	2.04000	3.78000
1977A	67.7000	67.0000	7618.00	-1.600000	1.26000
1978A	69.5000	68.2000	8658.00	890000	1.59000
1979A	71.2000	69.7000	9918.00	4.00000	3.08000
1980A	72.0000	70.9000	11467.0	9.05000	4.12000
1981A	73.9000	72.3000	13652.0	6.79000	5.65000
1982A	72.8000	71.4000	14923.0	5.01000	7.09000
1983A	71.4000	71.6000	15184.0	5.40000	7.49000
1984A	72.9800	72.1000	15753.0	9.40000	10.9100
1985A	72.0000	71.9000	16962.0	7.50000	8.98000
1986A	71.6000	72.1000	17504.0	7.20000	7.92000
1987A	72.8000	72.0000	18176.0	5.30000	6.97000

+ ID	RNHP	RPDY	RPY	RSALA	RSALB1
1971A	67.6000	6407.93	7878.79	2422.00	5645.69
1972A	72.4000	7111.87	8668.95	2728.00	6228.31
1973A	80.9000	7674.37	9329.83	3070.00	6449.58
1974A	96.4000	8270.63	10191.9	3734.00	7166.99
1975A	103.500	8804.18	10802.4	4556.00	7896.01
1976A	114.800	8980.74	11170.1	5290.00	8491.17
1977A	112.400	9061.76	11202.9	5927.00	8716.18
1978A	110.100	9658.57	11684.2	6798.00	9174.09
1979A	108.900	10101.6	12290.0	8052.00	9977.70
1980A	106.700	10852.8	12898.8	9411.00	10586.1
1981A	100.000	11139.0	13652.0	10906.0	10906.0
1982A	88.5000	10783.0	13468.4	10941.0	9874.55
1983A	77.2000	10271.0	12955.6	11304.0	9645.05
1984A	70.6000	10461.0	13083.9	11833.0	9828.07
1985A	64.3000	11044.0	13657.0	13524.0	10888.9
1986A	66.7000	10965.0	13643.0	14338.0	11175.0
1987A	67.3000	10608.0	13595.0	14855.0	11111.0

+ ID	RSALB	RSALB1	RWOP	SA	SC
1971A	1007.80	2349.19	2.29000	NA	NA
1972A	1152.98	2632.38	2.36000	1504.00	1497.00
1973A	1352.33	2841.03	4.22000	1665.00	626.000
1974A	1714.40	3290.59	7.02000	2841.00	2902.00
1975A	2094.20	3629.46	6.15000	2062.00	2034.00
1976A	2300.98	3693.38	5.64000	4300.00	4299.00
1977A	2720.00	4000.00	5.80000	3733.00	3759.00
1978A	3173.55	4282.79	6.33000	4101.00	4484.00
1979A	3741.79	4636.67	10.8400	4117.00	4990.00
1980A	4037.98	4542.16	12.5400	3640.00	3586.00
1981A	4491.90	4491.90	10.0700	4305.00	4359.00
1982A	4405.10	3975.72	8.91000	2852.00	2256.00
1983A	4079.20	3480.54	7.14000	3010.00	2473.00
1984A	4699.33	3903.10	6.92000	2640.00	2540.00
1985A	4555.00	3667.47	6.52000	1638.00	1596.00
1986A	4829.00	3764.00	3.94000	1937.00	1929.00
1987A	5003.00	3742.00	5.00000	1918.00	1936.00

+ ID	SI	SS	TA	TC	TO
1971A	NA	NA	NA	NA	2653.99
1972A	146.000	1651.00	7829.00	7484.00	3477.99
1973A	107.000	2313.00	7377.00	7109.00	3477.99
1974A	168.000	2355.00	5772.00	5510.00	3481.49
1975A	140.000	3996.00	3529.00	3504.00	4318.19
1976A	139.000	3723.00	6665.00	6663.00	4795.19
1977A	189.000	3207.00	10152.0	10980.0	5397.34
1978A	429.000	5434.00	12399.0	13574.0	6195.54
1979A	1302.00	4138.00	10886.0	12641.0	6783.69
1980A	1248.00	3191.00	8787.00	8176.00	7427.59
1981A	1302.00	4046.00	9760.00	9641.00	8166.29
1982A	727.000	1812.00	9799.00	9550.00	9206.55
1983A	190.000	3003.00	9156.00	7744.00	8888.78
1984A	93.0000	1750.00	4224.00	3738.00	9972.71
1985A	53.0000	1890.00	2045.00	1891.00	10133.0
1986A	45.0000	1813.00	2120.00	2083.00	10953.4
1987A	61.0000	2161.00	2187.00	2180.00	11206.3

+ ID	TS	TSO	UR	URA	URC
1971A	NA	2724.00	5.20000	5.70000	6.20000
1972A	6764.00	3517.99	5.10000	5.60000	6.20000
1973A	4722.00	3517.99	4.70000	5.30000	5.50000
1974A	3767.00	4440.99	3.10000	3.50000	5.30000
1975A	6947.00	4865.48	4.00000	4.20000	6.90000
1976A	10259.0	5531.48	4.00000	4.00000	7.10000
1977A	10651.0	6900.48	4.30000	4.50000	8.10000
1978A	14668.0	7230.48	4.70000	4.70000	8.30000
1979A	9682.00	7663.98	3.70000	3.90000	7.40000
1980A	8446.00	8953.70	4.10000	3.70000	7.50000
1981A	10517.0	9438.70	4.10000	3.80000	7.50000
1982A	9112.00	10370.9	8.00000	7.70000	11.0000
1983A	5056.00	13253.6	12.1000	10.8000	11.9000
1984A	1877.00	12984.4	14.1000	11.2000	11.3000
1985A	1970.00	13384.9	12.2000	10.1000	10.5000
1986A	1910.00	13438.4	11.5000	9.80000	9.80000
1987A	2366.00	13441.5	11.3000	9.60000	8.90000

+ ID	VR	VS	WAP	WAPA	WOP
1971A	2.50000	70.0000	341.000	1081.00	2.29000
1972A	1.10000	40.0000	331.000	1111.00	2.48000
1973A	1.00000	36.5000	355.000	1145.00	5.04000
1974A	3.40000	122.800	394.000	1190.00	11.2500
1975A	1.60000	70.2900	409.000	1244.00	11.2500
1976A	2.40000	134.140	419.000	1302.00	11.5000
1977A	10.2000	704.904	417.000	1356.00	12.7000
1978A	6.20000	446.790	438.000	1409.00	15.0000
1979A	3.10000	236.390	453.000	1503.00	28.7500
1980A	8.70000	787.410	481.000	1579.00	38.0000
1981A	.500000	232.149	502.000	1657.00	34.0000
1982A	14.3000	1482.08	518.000	1718.00	34.0000
1983A	24.8000	3280.93	528.000	1745.00	29.0000
1984A	22.0000	2851.44	523.000	1740.00	29.0000
1985A	20.5000	2737.86	552.000	1738.00	28.0000
1986A	18.5000	2484.94	563.000	1762.00	15.0700
1987A	15.3000	2235.17	563.000	1768.00	19.0000

+ ID	WR	WRA
1971A	130.420	138.770
1972A	142.440	150.080
1973A	153.080	161.120
1974A	171.300	178.720
1975A	197.740	207.380
1976A	219.030	236.890
1977A	241.090	261.960
1978A	257.650	276.320
1979A	291.120	306.810
1980A	320.540	341.930
1981A	363.310	390.400
1982A	399.730	435.470
1983A	409.810	429.350
1984A	414.710	439.270
1985A	425.550	445.340
1986A	428.490	448.090
1987A	431.270	450.280